Vol. XXXI JANUARY-FEBRUARY-MARCH, 1948 No. 3

# THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

## CONTENTS


| | | |
|---|---|---|
| Morphogenetic Effects of 2,4-D on Some Philippine Crop Plants | *By Cesar A. Villariba and José M. Capinpin* | 163 |
| Heterosis in Datura Crosses | *By Pedro A. David* | 177 |
| On Clonal Reproduction of Rice | *By José M. Capinpin and Felix B. Villamayor* | 185 |
| Cost of Producing Guinea Grass, Napier Grass, and Para Grass for Soiling in 1940-1943 | *By José P. Esguerra* | 192 |
| The Influence of Different Kinds of Animal Manure on the Yield of the Eggplant | *By Vicente M. Dawis and Federico L. Labis* | 199 |
| The Performance of Three Varieties of Rice When Planted Late in the Season | *By Rufo H. Ocfemia and Valeriano C. Calma* | 206 |
| The Fertility of Muscovy Duck Eggs | *By Lamberto J. Tolentino* | 212 |
| Effects upon the Yield of Ramai Rice of Ammonium Sulfate, Ammo-Phos, and a Home-Mixed Fertilizer | *By Valeriano C. Calma and Saturnino G. Rico* | 216 |
| Distillery Yeast, a Possible Feed for Poultry | *By F. M. Fronda and Melchor E. Fronda* | 222 |
| Yields of Broadcast and Transplanted Seraup Kechil 36 Rice | *By Guillermo T. Palis and Valeriano C. Calma* | 226 |
| An Additional Insect Vector of Bunchy-top of Abacá, or Manila Hemp Plant | *By R. C. Espino and G. O. Ocfemia* | 231 |
| A Review: Poultry Production | *By F. M. Fronda* | 233 |
| College and Alumni Notes | | 235 |


★

*Published by*
THE COLLEGE OF AGRICULTURE
UNIVERSITY OF THE PHILIPPINES

TH MYCOLOGICAL INSTITUTE
19 JUL 1948
COMM. ★

# The Philippine Agriculturist

**(University of the Philippines Publications Series A)**


Editor

L. B. UICHANCO, SC.D. ..... *Dean, College of Agriculture*

Managing Editor

G. O. OCFEMIA, PH.D. ..... *Professor of Plant Pathology*

Copy Editor

AURORA L. SAMONTE, B.S.E. ..... *Assistant Professor of English*

Business Manager

JOSÉ M. CAPINPIN, PH.D. ..... *Assistant Professor of Agricultural Botany*

Advisory Board

R. B. ESPINO, PH.D. ..... *Head, Department of Agricultural Botany*
F. O. SANTOS, PH.D. ..... *Head, Department of Agricultural Chemistry*
A. B. CATAMBAY, M.S. ..... *Head, Department of Agricultural Engineering*
VALENTE VILLEGAS, PH.D. ..... *Head, Department of Animal Husbandry*
DIONISIO I. AQUINO, PH.D. ..... *Acting Head, Department of Soils*
FRANCISCO M. SACAY, PH.D. ..... *Head, Department of Agricultural Education*
LEON G. GONZALEZ, PH.D. ..... *Head, Department of Agronomy*


Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.


THE PHILIPPINE AGRICULTURIST is published quarterly, beginning with Volume 31, by the College of Agriculture, University of the Philippines, in Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U. S. currency) elsewhere; the price of single copies is ₱2.00 in the Philippines and $1.00 (U. S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

# MORPHOGENETIC EFFECTS OF 2,4-DICHLOROPHENOXYACETIC ACID ON SOME CROP PLANTS[1]

CESAR A. VILLARIBA AND JOSÉ M. CAPINPIN
*Of the Department of Agricultural Botany*

The use of 2,4-dichlorophenoxyacetic acid (commonly referred to as 2,4-D) both as a growth regulator and as a selective herbicide is advantageous because the material is cheap and nontoxic to animals. The application of 2,4-D as a chemical plant hormone results in a variety of biologic effects and plant responses. Among such effects are increased fruit setting and parthenocarpic induction in tomatoes (Howlett, 1941; Zimmerman, 1941; Gustafson, 1942; and Strong, 1946), unchanged vitamin C content of ripe fruits that develop from treated tomato flowers (Mitchell and Whitehead, 1942), flower inducing power in pineapple (Overbeek, 1945), pollen abortion in ragweed (Grigsby, 1946), and fruit drop control in oranges and apples (Rees, 1947). The objects of the present experiments were to record the morphogenetic changes brought about by 2,4-D treatments on some Philippine crop plants and to indicate possible bearing on practical crop improvement work.

## MATERIALS AND METHODS

The form used of the growth regulator 2,4-dichlorophenoxyacetic acid was a commercial product under the trade name "Dox Weed Killer," which is manufactured by the California Chemical Spray Corporation, Richmond, California.

Aqueous solutions of the desired concentrations of 2,4-D were prepared by dissolving the weighed amounts of the chemical in water. Fresh solutions of 2,4-D were applied with the aid of a DeVilbiss atomizer, care being taken to confine the spray to the inflorescence. Hitchcock and Zimmerman (1935), Strong (1946), and Taylor (1946) had noted that stem curvature, or epinasty, proliferations of various plant parts, and formation of gall-like growths are common responses to even a droplet of spray application of this compound. To prevent these undesirable effects, every precaution was taken to keep the reagent from the stems and leaves.

All applications were made during warm sunny days. Exception, however, was made with the application of 2,4-D on tomato during the rainy months when spraying was done without regard to weather conditions.

---

[1] Experiment Station contribution No. 1473. Based on a thesis presented by the senior author for graduation with the degree of Bachelor of Science in Agriculture. Read by the junior author before the Los Baños Biological Club on October 31, 1947.

The crop plants studied were the eggplant, tomato, papaya, corn, and rice. All these plants were grown in field plots, except the papaya, which were already growing when the work was started. Insects, particularly tomato pests, were controlled by handpicking and not by spraying with insecticides, which might complicate results.

## EXPERIMENTS AND RESULTS

### *Eggplant*

Two plantings of the Long White variety of the eggplant were made, one on December 12, 1946, and the other on April 23, 1947. Each planting or set was divided into four lots, ten plants to a lot.

The first lot was treated on March 24 to 27, 1947, when all plants flowered profusely. The flower buds and open flowers were sprayed once. The first lot, which served as control, did not receive any 2,4-D treatment. The second, third, and fourth lots were treated with varying concentrations of 2,4-D, namely, 10, 25, and 50 parts per million, respectively. As fruits approached maturity the rate of growth in length was measured, and the fruits were harvested when very little or no growth at all was noted. This method was used as the criterion for maturity. Results of the treatment may be seen in table 1.

The second planting, which had the same setup as the first, was treated from June 13 to 15, 1947. The results of this experiment are shown in table 2.

Varying results were obtained from the dry- and wet-season applications. Results shown in table 1 seem to indicate that fruit set was not increased by the dry-season application of 2,4-D spray in concentrations of 10 and 25 parts per million. On the contrary, a concentration of 50 parts per million proved to be harmful, as shown by the reduced percentage fruit set that resulted from such treatment. The difference between the percentage fruit set of the 50-parts-per-million treatment and that of the untreated lot was statistically very significant.

On the other hand, judging from the results (table 2) obtained from the wet-season application, fruit set was increased from 75 per cent to as high as 88.36 per cent in the 10-parts-per-million treatment and 92.18 per cent in the 25-parts-per-million treatment. Differing from the results obtained from the dry-season application, the results from a concentration of 50 parts per million in the wet-season application showed that fruit set was not reduced.

With regard to the induction of parthenocarpic fruits, higher percentages were obtained from the dry-season application than from the wet-season application. These results were probably due to the rainy period

which coincided with the experiment. As shown in table 1, as much as 85.71 per cent of the fruits that developed from flowers treated with a concentration of 50 parts per million were parthenocarpic. Statistical treatment of the results showed that the highest percentage of parthenocarpic fruits was induced with this concentration, fairly high with 25 parts per million, and low with 10 parts per million.

In the wet-season application, however, the percentages of parthenocarpic fruits obtained from both 25-and-50-parts-per-million treatments were statistically the same. A concentration of 10 parts per million was less effective in inducing parthenocarpy.

Except in a few cases, the number of seeds of nonparthenocarpic fruits that developed from treated flowers were considerably reduced. The experiment was not carried far enough to determine whether such seeds were sterile or not.

Parthenocarpic fruits matured from two to six days earlier than those that developed from untreated flowers. No difference in maturity was observed between seeded fruits which developed from treated flowers and those which developed from untreated flowers. As shown in table 1, however, the average maturity days of both parthenocarpic and nonparthenocarpic fruits that developed from treated flowers was statistically lower than that of fruits that developed from untreated flowers.

On the other hand, the average number of days from blossoming to maturity of those in the control and those which received the 10-parts-per-million treatment were the same in the wet-season application. With the 25-and-50-parts-per-million treatments, the number of the average maturity days was reduced by two days, the difference being significant when compared with that of the control.

Striking morphological effects of 2,4-D spray were observed. Most flower buds treated with this growth-regulating substance, especially in a concentration of 50 parts per million, did not develop to full-sized fruits, and there was markedly intense gall-like growth on the fruit. Fruits that developed from open flowers which received the 25-parts-per-million treatment were normal in size and even slightly larger than those that developed from untreated flowers. Several deformed fruits were produced in the 50-parts-per million lot, and gall-like growths on the fruits were more pronounced in this concentration than in the lower ones.

Although spray treatments were confined only to the flowers, stem curvature and growth of axillary shoots on the second node were noticed in some plants. These results are in general agreement with those reported by Hitchcock and Zimmerman (1935) and Strong (1946). Such effects were termed telemorphic by Beal (1944).

Stem curvature responses produced by 2,4-D application were more pronounced in the dry-season experiment than in the wet-season. These observations support the contention of Weaver and Derose (1946) that the absorption and translocation of 2,4-D in plants are much faster if sunny weather prevails after treatment.

Under the conditions of these experiments it appears that 25 parts per million is the best concentration of 2,4-D spray for inducing parthenocarpy and increased fruit set as well as reducing the number of days from blossoming to maturity of the eggplant. It is suggested that further experiments of this nature be carried out to formulate general recommendations for the use of 2,4-D as a possible aid in the commercial production of the eggplant.

*Tomato*

The Susong Kalabaw variety of tomato was used. As in the experiment with the eggplant, two plantings were made. The first planting was done on January 2, 1947, and the second on May 12, 1947. The setup of the experiments with the tomato was similar to that made with the eggplant, except that there were twelve plants to a lot.

Treatment of the first set was done March 21 to 26, 1947. The first lot served as control; the second, third, and fourth lots were treated with different concentrations of 2,4-D, namely, 10, 25, and 50 parts per million. Zimmerman (1943) found that a concentration of this growth-regulating substance of 10 parts per million was effective in inducing a high percentage of parthenocarpy in greenhouse tomatoes. Inasmuch as the tomato plants in the present study were grown under field conditions it was supposed that good results might be obtained with higher concentrations. Spraying was done when two to three flowers were open in a cluster. Strong (1946) found that spray application during this period is conducive to increased fruit setting and high percentage of parthenocarpic tomato fruit.

The fruits were harvested when their color changed from light green to pale red. The results of this treatment may be seen in table 3.

Treatment of the second set was started on June 3, 1947, and completed on June 13, 1947. The plants did not flower at the same time, and as a consequence, treatment of all the plants in the second, third, and fourth lots was delayed. Also, the weather was unfavorable during this period. Occasional showers usually accompanied or followed the application of the spray treatment. Nevertheless, spray application was completed irrespective of weather conditions when the rest of the untreated plants were in bloom. The results of this experiment may be seen in table 4.

As may be seen in tables 3 and 4, statistical treatment of the results indicates that desirable results were obtained with a concentration of 25

parts per million. While fruit set was not increased in the dry-season application, it was increased considerably in the wet-season experiment. In both seasons, percentages of parthenocarpic fruits were as high as the percentage of those treated with 50 parts per million, and averages of the number of days from blossoming to fruit maturity were lower by five to nine days than those of the control.

Cases of severe deformation of the leaves were noted in all the treated lots. Fruits produced with the use of higher concentrations (25 and 50 parts per million) were sometimes deformed, and a characteristic cankerous spot was often noted on parthenocarpic fruits.

Contrary to the results reported by Zimmerman (1943) and Strong (1946), the concentration of 10 parts per million was not the best to use under the experimental conditions that obtained in the present investigation. Judging from the results of the experiment with the tomato, this concentration failed to produce favorable results decidedly different from those of the untreated lots. There are possible explanations to these conflicting results. The plants used in the present study were grown under field conditions in humid tropical climate whereas those used by the foreign investigators were grown under greenhouse conditions. Also, the chemical used in the present study was of the commercial weed-killer type, as it was the only one available when the investigation was conducted. Climatic factors, methods of preparation, spraying techniques, varietal differences—all might have been involved.

In general agreement with the report of Strong (1946), the results of the present study conclusively prove that 2,4-D is an exceedingly potent hormone for the production of parthenocarpic tomato but has very undesirable deforming effects on foliage.

As yet, no general recommendations for the use of 2,4-D spray for the commercial production of tomatoes can be made on the basis of the present limited experiments. Results of the present tests indicate, however, that production of parthenocarpic fruits may be achieved with the use of a concentration of 25 parts per million of 2,4-D spray on the Susong Kalabaw variety of the tomato.

### *Corn*

Corn was planted on May 6, 1947, five plants to each of the five lots made. As soon as ears formed they were bagged to prevent pollination. On July 4, 1947, the bags were removed and the ears were artificially pollinated. Forty-eight hours later, 2,4-D was sprayed on the silk. The first lot, which served as control, did not receive any treatment. The second, third, fourth, and fifth lots were treated with 2,4-D spray with varying concentrations, namely, 10, 25, 50, and 100 parts per million, respectively.

All ears, including those of the control, were bagged after the treatment.

On August 1, 1947, the ears were harvested. The results of this experiment are shown in table 5.

It is shown in table 5 that the concentration of 100 parts per million of 2,4-D spray was the most effective in inducing pollen sterility in corn. The concentration of 50 parts per million was almost as effective. Lower concentrations (10 and 25 parts per million) induced pollen sterility to a limited degree.

No foliar deformation was observed although the spraying was done indiscriminately. This indicates that corn has a high degree of tolerance when 2,4-D is sprayed on the leaves. This fact may prove of value in selective herbicidal control of weeds.

*Rice*

On May 6, 1947, seeds of the Inintiw variety of rice were sown in a row of twenty-five hills. A month later, the seedlings were thinned to one plant to a hill. The row was divided into five lots, each lot containing five plants.

When the plants were flowering during the first week of September, 1947, the flowers were sprayed at ten o'clock in the morning to coincide with dehiscence. Not all the flowers were open at any one time so that each inflorescence was sprayed twice at an interval of two days. As in the experiment with corn, the first lot was used as control and the second, third, fourth, and fifth lots were treated with the growth-regulating substance in concentrations of 10, 25, 50, and 100 parts per million, respectively.

On September 24, 1947, the mature panicles were harvested and weighed. Table 6 shows the results of this experiment.

The reduced weights of filled grains produced by such concentrations as 25, 50, and 100 parts per million of 2,4-D spray indicate that this growth-regulator is potent in inducing pollen sterility in rice (see table 6). Preponderance of empty light gray grains seemed to be the characteristic effect of 2,4-D when sprayed on the inflorescence.

As in corn, detrimental effects were not noted on the leaves of rice. This seems to agree favorably with the report of Taylor (1946) that cereal crops are more resistant than broadleaved crops. A program of weed control in cereals using 2,4-D, however, would seem hazardous, considering the morphological responses of young cereal plants to this growth regulator. Wilting and drying of leaves and swelling of the crown region, from which the growth of adventitious roots was stimulated, were noted on cereals by Taylor (1946). Kraus and Mitchell (1946) reported that young rice plants were killed by the application of 2,4-D to the water surrounding the plants as well as to their leaf surface.

*Papaya*

A very seedy variety of papaya was used in the experiment. Eight plants were grouped in twos, each group constituting a lot. Within the period from July 10 to July 20, 1947, flowers of the second, third, and fourth lots were given one spray treatment of 2,4-D in concentrations of 10, 20, and 30 parts per million, respectively.

The criterion used for maturity was the appearance of a yellowish coloration on the fruit. The results of this experiment are shown in table 7.

No entirely seedless papaya fruits were obtained in the experiment, but it was very interesting to note that the number of seeds was considerably reduced in the fruits that developed from flowers treated with 2,4-D spray. The number of days from flowering to fruit maturity was also significantly reduced by as much as five to eleven days.

A concentration of 30 parts per million appeared to be slightly toxic as shown by the significant reduction in fruit set from 95 per cent in the untreated lot to 50 per cent in the lot which was treated with a concentration of 30 parts per million of the growth regulator. There was no reduction in fruit set in the lot treated with a concentration of 10 parts per million but the percentage of low-seeded fruits was only 33.33 per cent. A concentration of 20 parts per million seems to be intermediate between the two limits. It struck a satisfactory balance between beneficial and harmful effects. While fruit set was slightly reduced to 81.8 per cent by this concentration, the percentage of low-seeded fruits was fairly high, considering that the difference between 72.22 per cent and 33.33 per cent was highly significant (table 7).

It is probable that entirely seedless papaya fruits may yet be induced by 2,4-D treatment with slightly higher concentrations than 30 parts per million, but it is logical to expect an unfavorable reduction in fruit set. Under the conditions of the experiments, a concentration of 40 parts per million did not induce fruit set at all.

## SUMMARY

1. In the experiment with the eggplant the best concentration of 2,4-D spray for inducing parthenocarpy and increased fruit set, as well as for reducing the number of days from blossoming to fruit ripening, was 25 parts per million. Application of the treatment on newly opened flowers during warm days gave satisfactory results. Eating quality of seedless fruits that were produced by such treatment compared favorably with that of ordinary seeded ones.

2. 2,4-D, at a concentration of 25 parts per million, is an exceedingly potent hormone for the production of parthenocarpic tomato and inducing

increased fruit set, but it has very undesirable deforming effects on foliage when used as spray.

3. A concentration of 100 parts per million of 2,4-D spray induced pollen sterility in corn, but it had no observable effect on the leaves.

4. Concentrations of 50 to 100 parts per million of 2,4-D likewise caused pollen sterility in rice, but, as in corn, it showed no influence on the leaves.

5. The 2,4-D spray treatment induced the production of low-seeded papaya fruits and decreased the number of days from blossoming to fruit ripening by as much as five to eleven days. The optimum concentration found was 25 parts per million.

LITERATURE CITED

BEAL, J. M. 1944. Some telemorphic effects induced in sweet pea by application of 4-chlorophenoxyacetic acid. Bot. Gaz. **105**: 471-474.

GRIGSBY, B. H. 1946. Some effects of 2,4-D on ragweed. Amer. Jour. Bot. **33**: 124-129.

GUSTAFSON, F. G. 1942. B-naphtoxyacetic acid as an inductor of parthenocarpy in tomatoes. Proc. Amer. Soc. Hort. Sci. **40**: 387–389.

HITCHCOCK, A. E., AND P. W. ZIMMERMAN. 1935. Absorption and movement of synthetic growth substances from soil as indicated by the response of aerial parts. Contrib. Boyce Thompson Inst. **7**: 447–476.

HOWLETT, F. S. 1941. Use of chemicals to stimulate fruitfulness in tomatoes. Ann. Rep. Veg. Growers Assoc. America 1941: 1–13.

KRAUS, E. J., AND J. W. MITCHELL. 1947. Growth-regulating substances as herbicides. Bot. Gaz. **108**: 301-331.

MITCHELL, J. W., AND M. R. WHITEHEAD. 1942. Effects of vaporous naphtoxyacetic acid on development of tomato fruits, with special reference to their vitamin C content. Bot. Gaz. **104**: 362-365.

VAN OVERBEEK, J. 1945. Flower formation in the pineapple plant as controlled by 2,4-D and naphthaleneacetic acid. Science **102** (2659): 621.

REES, CHARLES C. (editor) 1947. Orchards. Country Gentleman **117** (8): 38-39.

STRONG, M. C. 1946. Use of 2,4-D for the improvement of greenhouse tomato production. Amer. Jour. Bot. **33**: 130–141.

TAYLOR, V. L. 1946. Observation on the growth of certain plants in nutrient solutions containing growth-regulating substances: 1. Some effects of 2,4-D acid. Bot. Gaz. **107**: 597–611.

WEAVER, R. J., AND H. ROBERT DEROSE. 1946. Absorption and translocation of 2,4-D Bot. Gaz. **107**: 509-521.

ZIMMERMAN, P. W. 1941. Growth regulators of plants and formative effects induced with B-naphthoxy compounds. Proc. Nat. Acad. Sci. **27**: 381-388.

ZIMMERMAN, P. W. 1943. The present status of plant hormones. Indust. Engin. Chem. **35**: 596.

TABLE 1

*Effects of varying concentrations of 2,4-D on the Long White variety of the eggplant applied on March 24 to 27, 1947*

| LOT | NUMBER OF PLANTS | AV. NO. OF FLOWERS TO A PLANT | TREATMENT | FRUIT SET | | PARTHENOCARPIC FRUITS | | AVERAGE NUMBER OF DAYS FROM BLOSSOMING TO FRUIT MATURITY [c] |
|---|---|---|---|---|---|---|---|---|
| | | | | Av. No. of fruits to a plant | Percentage fruit set [a] | Av. No. to a plant | Percentage [b] | |
| | | | *p.p.m.* | | | | | |
| I | 10 | 5.4 | 0 | 3.7 | 68.51 | 0.0 | 0.00 | 20.0 |
| II | 10 | 4.8 | 10 | 3.3 | 68.75 | 1.7 | 51.66 | 18.0 |
| III | 10 | 5.1 | 25 | 4.0 | 78.43 | 2.8 | 70.00 | 17.5 |
| IV | 10 | 6.1 | 50 | 1.4 | 22.95 | 1.2 | 85.71 | 17.4 |

[a] 12.68 per cent level of significance used as a basis for comparison
[b] 13.38 per cent level of significance used as a basis for comparison
[c] 0.82 day level of significance used as a basis for comparison

TABLE 2

*Effects of varying concentrations of 2,4-D on the Long White variety of the eggplant applied June 15, 1947, to June 13, 1947*

| LOT | NUMBER OF PLANTS | AV. NO. OF FLOWERS TO A PLANT | TREATMENT | FRUIT SET | | PARTHENOCARPIC FRUITS | | AVERAGE NUMBER OF DAYS FROM BLOSSOMING TO FRUIT MATURITY [c] |
|---|---|---|---|---|---|---|---|---|
| | | | | Av. No. of fruits to a plant | Percentage fruit set [a] | Av. No. to a plant | Percentage [b] | |
| | | | *p.p.m.* | | | | | |
| I | 10 | 4.0 | 0 | 3.5 | 75.00 | 0.0 | 0.00 | 20.1 |
| II | 10 | 4.3 | 10 | 3.8 | 88.36 | 0.8 | 21.06 | 19.9 |
| III | 10 | 6.4 | 25 | 5.9 | 92.18 | 2.9 | 49.15 | 18.0 |
| IV | 10 | 5.9 | 50 | 4.5 | 76.27 | 2.5 | 55.55 | 17.5 |

[a] 11.49 per cent level of significance used as a basis for comparison
[b] 11.76 per cent level of significance used as a basis for comparison
[c] 0.83 day level of significance used as a basis for comparison

TABLE 3

*Effects of varying concentrations of 2,4-D on the Susong Kalabaw variety of the tomato applied March 26, 1947, to March 31, 1947*

| LOT | NUMBER OF PLANTS | AV. NO. OF FLOWERS TO A PLANT | TREATMENT | FRUIT SET | | PARTHENOCARPIC FRUITS | | AVERAGE NUMBER OF DAYS FROM BLOSSOMING TO FRUIT MATURITY [c] |
|---|---|---|---|---|---|---|---|---|
| | | | | Av. No. of fruits to a plant | Percentage fruit set [a] | Av. No. to a plant | Percentage [b] | |
| | | | *p.p.m.* | | | | | |
| I | 12 | 18.6 | 0 | 8.1 | 43.54 | 0.0 | 0.00 | 31.5 |
| II | 12 | 23.6 | 10 | 10.8 | 41.52 | 1.4 | 12.98 | 29.5 |
| III | 12 | 20.5 | 25 | 13.4 | 65.36 | 9.8 | 73.13 | 27.0 |
| IV | 12 | 19.2 | 50 | 7.8 | 40.62 | 6.1 | 78.46 | 26.55 |

[a] 8.55 per cent level of significance used as a basis for comparison
[b] 3.87 per cent level of significance used as a basis for comparison
[c] 1.46 days level of significance used as a basis for comparison

TABLE 4

*Effects of varying concentrations of 2,4-D on the Susong Kalabaw variety of the tomato applied June 3, 1947, to June 13, 1947*

| LOT | NUMBER OF PLANTS | AV. NO. OF FLOWERS TO A PLANT | TREATMENT | FRUIT SET | | PARTHENOCARPIC FRUITS | | AVERAGE NUMBER OF DAYS FROM BLOSSOMING TO FRUIT MATURITY [c] |
|---|---|---|---|---|---|---|---|---|
| | | | | Av. No. of fruits to a plant | Percentage fruit set [a] | Av. No. to a plant | Percentage [b] | |
| | | | *p.p.m.* | | | | | |
| I | 12 | 26.4 | 0 | 16.8 | 63.63 | 0.0 | 0.00 | 32.5 |
| II | 12 | 26.7 | 10 | 17.0 | 63.29 | 3.9 | 22.94 | 31.0 |
| III | 12 | 28.8 | 25 | 20.4 | 70.48 | 19.2 | 94.11 | 24.0 |
| IV | 12 | 32.4 | 50 | 10.6 | 32.71 | 10.3 | 97.17 | 24.0 |

[a] 13.23 per cent level of significance used as a basis for comparison
[b] 7.26 per cent level of significance used as a basis for comparison
[c] 1.83 days level of significance used as a basis for comparison

TABLE 5

*Effects of varying concentrations of 2,4-D spray applied on the ears of corn 48 hours after pollination*

| LOT | NUMBER OF PLANTS | NUMBER OF EARS TREATED | TREATMENT | NUMBER OF KERNELS | |
|---|---|---|---|---|---|
| | | | | Total | Average number to an ear [a] |
| | | | *p.p.m.* | | |
| I | 5 | 10 | 0 | 2552 | 252.2 |
| II | 5 | 9 | 10 | 598 | 66.4 |
| III | 5 | 8 | 25 | 223 | 27.7 |
| IV | 5 | 9 | 50 | 67 | 7.4 |
| V | 5 | 10 | 100 | 6 | 0.7 |

[a] 17.5 kernels level of significance used as a basis for comparison

TABLE 6

*Effects of varying concentrations of 2,4-D spray on rice applied during the flowering stage from September 1, 1947, to September 5, 1947*

| LOT | NUMBER OF PLANTS | AVERAGE NUMBER OF PANICLES TO A PLANT | TREATMENT | AVERAGE WEIGHT OF FILLED GRAINS TO A PANICLE [a] |
|---|---|---|---|---|
| | | | *p.p.m.* | *grams* |
| I | 5 | 5 | 0 | 1.25 |
| II | 5 | 3 | 10 | 1.23 |
| III | 5 | 4 | 25 | 1.09 |
| IV | 5 | 5 | 50 | 0.70 |
| V | 5 | 3 | 100 | 0.50 |

[a] 0.19 gram level of significance used as a basis for comparison

TABLE 7

*Effects of varying concentrations of 2,4-D spray on papaya applied from July 10, 1947, to July 24, 1947*

| LOT | NUMBER OF PLANTS | AV. NO. OF FLOWERS TO A PLANT | TREATMENT | FRUIT SET | | PARTHENOCARPIC FRUITS | | AVERAGE NUMBER OF DAYS FROM BLOSSOMING TO FRUIT MATURITY [c] |
|---|---|---|---|---|---|---|---|---|
| | | | | Av. No. of fruits to a plant | Percentage fruit set [a] | Av. No. to a plant | Percentage [b] | |
| | | | *p.p.m.* | | | | | |
| I | 2 | 10 | 0 | 9.5 | 95.00 | 0.0 | 0.00 | 55.3 |
| II | 2 | 8 | 10 | 7.5 | 93.75 | 2.5 | 33.33 | 50.5 |
| III | 2 | 11 | 20 | 9.0 | 81.80 | 6.5 | 72.22 | 45.0 |
| IV | 2 | 7 | 30 | 3.5 | 50.00 | 3.0 | 85.14 | 44.0 |

[a] 11.3 per cent level of significance used as a basis for comparison
[b] 12.4 per cent level of significance used as a basis for comparison
[c] 5.1 days level of significance used as a basis for comparison

# HETEROSIS IN DATURA CROSSES[1]

PEDRO A. DAVID
*Of the Department of Agronomy*

WITH ONE TEXT FIGURE

Heterosis in the first-generation crosses between two horticultural races of *Datura metel* Linn. was studied in the culture plots of the Department of Agronomy, College of Agriculture, from November, 1945, to June, 1947.

## MATERIALS

### *Datura strains used*

Two distinct horticultural races of *D. metel* Linn. with contrasting characters of stem and flower color, corolla doubling, and nature of fruit thorns were used.

Seeds of the first form, *D. m. fastuosa* Linn., locally known as *talong-punai morado*, were taken from a lone plant in a private garden at Del Carmen, San Fernando, Pampanga, on December 27, 1945. Only this particular form is grown in that locality. The stem is purple, and the leaves are petiolate, uneven at the base, ovate, and broadly serrate. The flowers are large (16-17 cm. long) and the rows of purple double petals not spreading, and funnel-shaped. The fruits are globose, smaller than those of *D. m. alba* Nees, with blunt thorns or spines, and contain on the average 114 flattened seeds.

The original seeds of the second form, *D. m. alba*, locally called *talong-punai puti*, were collected on November 20, 1945, from a single plant growing in an isolated yard in Mayondon, Los Baños, Laguna, where only the white-flowered variety was raised. The stem of the plant is green and the leaves are petiolate, ovate, uneven at the base, and broadly serrate. The trumpet-like flowers are large (17-19 cm. long), with green sepals, and each with a single row of petals spreading or open at the distal end. The fruits, which are green, globose, and thorny, contain an average of 165 kidney-shaped seeds each.

## PROCEDURE

The seeds of the parent plants were cleaned, dried, and planted in small plots of equal sizes and of relatively uniform soil fertility. The seeds, planted about 80×100 cm. apart, at the rate of three seeds to the hill, germinated in 12 to 30 days after planting. When the plants were 15 to 30 centimeters

[1]Experiment Station contribution No. 1474.

high, two of the seedlings in each hill were carefully pulled out, leaving only the strongest plant behind. The plants were cultivated every fifteen days and were given the same field treatment until flowering time.

*Selection of parent plant*

The parent plants in the different culture plots were carefully examined before they began to bloom, and selection of the best individuals for hybridization work was made. Two plants of *Datura fastuosa* and two of *Datura alba* were marked.

*Technique of emasculation*

After selecting the male and female parent plants, hybridization was performed. The pistillate flowers to be emasculated were selected before they opened. The stamens were removed by making a longitudinal cut with a pair of fine-pointed forceps through the corolla and cutting off one by one the fine filaments bearing the anthers. Emasculation was done before anthesis. The anthers were united or unopened and rather fragile at this time. Care was taken to avoid unnecessary mutilation of the flower. After emasculation, only the pistil, which is club-shaped at the tip, was inside the corolla. Then a paper bag was placed over the emasculated flower and left until the stigma of the pistil was ready for pollination. Flowers of the selected male parent of the same condition and age were also bagged.

*Pollination and care of the treated flowers*

At the end of the second or third day, depending on weather conditions, the emasculated flowers were ready to be pollinated as evidenced by the syrup-like substance which made the stigma appear moist and sticky. A bagged flower of the male parent was removed and the open anthers were gently rubbed on the stigmas of the emasculated pistillate flowers.

The pollinated flowers were again covered with paper bags to keep insects from entering the treated flowers and to prevent other possible causes of contamination. The pollinated flowers were labeled and left covered until the corolla withered and dropped off, leaving the young fruits on the plant. It took the fruits 53 to 73 days to mature.

*Crosses performed*

The crosses made and studied consisted of direct and reciprocal crosses between the two forms (*fastuosa* and *alba*).

*Field cultures of parental types and $F_1$ hybrids*

Parallel field cultures of the parents and their hybrids were conducted in different plots. The seeds were cleaned, dried, and planted $80 \times 100$ centimeters apart, and three seeds to a hill in prepared lots of uniform size

and nearly of the same soil fertility. Planting was made on November 11 to 13, 1946, and germination took place 30 days later. The seedlings were thinned to one a hill. All field treatments were made as uniform as possible during the growing period of the plants.

*Cultures of hybrids and their parents*

The parent plants and their hybrids were grown in exactly the same way to obtain a fair idea of the hybrid vigor in the characters studied. All plants in each plot were observed and random samples were taken for measurement and analysis of variance.

All data from the characters studied were statistically analyzed and compared, using the L.S.M.D. level of significance as basis.

## RESULTS AND DISCUSSION

*Heredity of leaf and stem characters*

In cross No. 1, (*fastuosa* × *alba*), the $F_1$ plants produced petiolate ovate leaves uneven at the base and broadly serrate with large purple stems. They reproduced closely the leaf characters and stem color of the female parent, *D. fastuosa.*

In cross No. 2 (*alba* × *fastuosa*), the $F_1$ plants produced leaf characters and a stem color similar to those of the male parent, *fastuosa.*

In both crosses the leaf characters and purple stems of *fastuosa* were dominant in the first-generation progeny.

*Heredity of flower color and corolla doubling*

The unopened flowers of all $F_1$ plants in the two crosses were slightly purple-colored on the nether side of the tip of the corolla and differed quite noticeably from the two parents. The opened flowers were large, spreading, trumpet-like, mostly double-petalled, white-colored on the upper surface and slightly purple on the nether side of the tip of the corolla.

Some $F_1$ plants exhibited flowers of both double and single corolla. It was observed that a single plant may produce two kinds of flowers but of different sizes. The flowers with double corolla were larger than those with single corolla. The petals of the flowers of $F_1$ plants varied in size and in form.

Of the single-petalled $F_1$ plants there were some that showed stamens provided with winglike structures.

The majority of the $F_1$ hybrid plants in both crosses produced double corollas. The first, or inner, whorl of petals is shorter than the second. Doubling in the $F_1$, however, was not so prominent as in the double-flowered parent, *fastuosa,* in which the inside, or first, corolla extended one or two

centimeters above the second. All double-corolla flowers produced by the $F_1$ plants had the first set of petals much shorter than the second set, and not extending beyond the second whorl of corolla as in *fastuosa*.

From these observations, the purple color of the flower appeared to be dominant over white. The doubling of corollas in $F_1$ flowers indicates that either *D. fastuosa* was not pure in its genetic constitution as regards factor or factors for double corolla, or doubleness behaved differently in heredity.

*Heredity of fruit spines or thorns*

As in *alba* all fruits produced by the $F_1$ plants in cross No. 1 and cross No. 2 had more prominent thorns and more kidney-shaped seeds in the fruit. The number of thorns or spines on the fruits of the $F_1$ plants varied to some extent, but all $F_1$ fruits were spiny (fig. 1, center). From this observation, it is seen that the factor or factors responsible for the presence of spines on the fruits is dominant over that for the absence of spines.

*Criteria of heterosis*

The following quantitative characters were statistically measured and used as bases in studying the manifestation of heterosis:

*Diameter of the stems.* A comparison of the average diameter of the stems one centimeter above the ground of $F_1$ plants and that of their respective parents taken when the plants were 7 months and 15 days old showed that the $F_1$ as a group produced significantly larger stems than either of their parents, also taken as a group (table 2). The average increase in $F_1$ hybrid plants compared with the larger-stemmed parent, *alba*, was 53.1 per cent in cross No. 1, and 58.8 per cent in cross No. 2 (table 1). In both crosses the $F_1$ plants showed larger stems than the average of the two parents, when the plants were 7 months and 15 days old (table 1).

*Number of fruits produced on each plant.* Eight months from the date of planting, the $F_1$ plants in the two crosses outyielded their more productive parents, as shown in table 1. The average yield in cross No. 1 was 35.6 per cent higher than the average of the two parents combined, or 24.6 per cent over that of the larger-fruit bearing parental variety, *alba*. In the case of cross No. 2, the $F_1$ plants exhibited an average increase of 36.8 per cent over the average of their parents, or 29.7 per cent higher than that of *alba*, the more productive parent. The $F_1$ plants in both crosses produced a greater number of fruit than the high-yielding parent (table 2).

*Number of seeds to the fruit.* At harvest the seeds contained in each fruit were counted and compared. In cross No. 1 the average number of seeds in each fruit of the two parents was compared with the average num-

ber of seeds in each fruit of the $F_1$ plants. An increase of 49.9 per cent over the average of the two parents was found (see table 1), or 23.7 per cent more than the average of the parent producing more seeds. Comparison

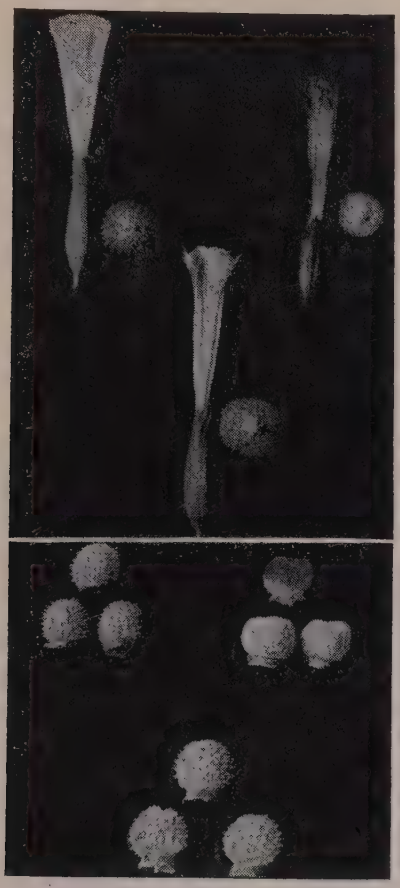

Fig. 1.—Flowers and fruits of parents and first-generation crosses between two horticultural races of *Datura metel* Linn. Upper picture, from left to right: Flowers of *alba* Nees, $F_1$ hybrid, and *fastuosa* Linn. Lower picture, from left to right: Fruits of *alba*, $F_1$ hybrid, and *fastuosa*. Photograph by Dr. Julian Banzon.

of the count of seeds in $F_1$ individual fruits and the average of the two parents showed that the $F_1$ in cross No. 2 gave 79.7 per cent more seeds, or 51.9 per cent over the seed count of the parent which produced a greater

number of seeds in each fruit (table 1). The $F_1$ plants contained more seeds than the more seedy parental race (table 2).

*Length of flowers.* In cross No. 1, the average length of flowers produced by the $F_1$ plants was 54.4 per cent longer than the average of the two parents combined, or 43.2 per cent more than the average length of the flowers of the parent producing long flowers (table 1). In cross No. 2, the $F_1$ plants also exhibited longer flowers than either parent (table 1). Like the other characters, the $F_1$ plants produced longer flowers than the longer-flower producing parent (table 2).

From these two *Datura* crosses which resulted in the production of larger diameter of stems, greater number of fruit on each plant, greater number of seeds in each fruit, longer flowers, and hence increased reproductivity and greater vegetative growth, may be seen that hybrid vigor finds expression in different ways.

### *Other observations*

Solanaceous wilt caused by *Phytomonas solanaceara* (E.F.S.) Bergey *et al.* (identified by the Department of Plant Pathology) attacked *alba* mostly. The $F_1$ plants and *fastuosa* were almost free from the disease.

### SUMMARY

1. The first-generation crosses between two distinct horticultural races of *Datura metel* Linn. (*fastuosa* and *alba*) collected from two different provinces manifested heterosis on the bases of (*a*) diameter of stems, (*b*) number of fruit on the plant, (*c*) number of seeds in the fruit, and (*d*) length of the flower tube.

2. *D. m. alba* produced larger stems, more fruit and seeds, and longer flowers than *fastuosa.*

3. In the first-generation hybrids (*a*) purple stem was dominant over green stem, (*b*) purple flower, over white flower, (*c*) presence of spines on fruits, over absence of spines, and (*d*) trumpet shape in flowers, over funnel shape.

4. Doubling of the corolla behaved differently. This can be ascertained only by further tests with $F_2$ plants.

TABLE 1

*Datura crosses compared with their parents*

| CHARACTERS | FASTUOSA | ALBA | AVERAGE OF TWO PARENTS | $F_1$ PLANTS | INCREASE OF $F_1$ OVER AVERAGE OF PARENTS |
|---|---|---|---|---|---|
| | | | | | *per cent* |
| 1. Diameter of stems in cm. | | | | | |
| Cross No. 1 [a] | 1.64 | 2.07 | 1.855 | 3.17 | 70.8 |
| Cross No. 2 [b] | 1.57 | 1.92 | 1.745 | 3.05 | 74.7 |
| 2. Number of fruit to the plant: | | | | | |
| Cross No. 1 | 14.45 | 17.25 | 15.850 | 21.50 | 35.6 |
| Cross No. 2 | 13.40 | 14.95 | 14.175 | 19.40 | 36.8 |
| 3. Number of seeds in a fruit: | | | | | |
| Cross No. 1 | 103.00 | 158.05 | 130.525 | 195.70 | 49.9 |
| Cross No. 2 | 114.20 | 165.35 | 139.775 | 251.30 | 79.7 |
| 4. Length of flowers in cm. | | | | | |
| Cross No. 1 | 16.54 | 19.34 | 17.940 | 27.70 | 54.4 |
| Cross No. 2 | 17.05 | 18.84 | 17.945 | 20.39 | 13.6 |

[a] Cross No. 1 (*fastuosa*×*alba*)

[b] Cross No. 2 (*alba*×*fastuosa*)

TABLE 2

*Summary of characters exhibited by the parental types and $F_1$ hybrids*

| STRAINS | MEAN | | | |
|---|---|---|---|---|
| | Diameter of stem | Number of fruits | Number of seeds | Length of flowers |
| | *cm.* | | | *cm.* |
| Cross No. 1 | | | | |
| *fastuosa* | 1.64 | 14.45 | 103.00 | 16.54 |
| *alba* | 2.07 | 17.25 | 158.05 | 19.34 |
| *fastuosa* × *alba*, $F_1$ | 3.17 | 21.50 | 195.70 | 27.70 |
| L.S.M.D.[a] | 0.37 | 2.75 | 32.82 | 0.54 |
| Cross No. 2 | | | | |
| *alba* | 1.92 | 14.95 | 165.35 | 18.84 |
| *fastuosa* | 1.57 | 13.40 | 114.20 | 17.05 |
| *alba* × *fastuosa*, $F_1$ | 3.05 | 19.40 | 251.30 | 20.39 |
| L.S.M.D.[a] | 0.27 | 2.28 | 15.37 | 0.84 |

[a] Level of significance as a basis for comparison 5% point.

# ON CLONAL REPRODUCTION OF RICE[1]

JOSÉ M. CAPINPIN AND FELIX B. VILLAMAYOR
*Of the Department of Agricultural Botany*

WITH TWO TEXT FIGURES

Earlier observations in the College indicate that asexual propagation of rice is possible by continuous ratooning of the plants. To replace the dead transplanted seedlings the rice farmers in Rizal and Laguna employ a process known as "hinulipan"[2] by which tillers are separated from vigorous rice plants. This study was conducted (*a*) to propagate rice asexually by using tillers detached from the mother plants, and (*b*) to determine the possibility of establishing rice clons by asexual means.

The work was performed in the experimental lots and in the Plant Genetics laboratory of the Department of Agricultural Botany, College of Agriculture, Los Baños, Laguna, from October, 1945, to July, 1946.

## MATERIALS AND METHODS

### *Variety used*

The rice used in this work was Macan Piña, a commercial variety in Rizal, which is an early maturing and profusely tillering variety. This is a dual-purpose variety, thriving well under irrigated and nonirrigated conditions.

### *Methods of planting*

*Preparation of seedbeds.* Two seedbeds were filled with clay loam soil. Poultry manure was mixed with the soil to increase the plant nutrient and to improve the water-holding capacity and texture of the soil. The soil was saturated with water as in an ordinary seedbed. On December 12, 1945, two liters of rice seeds contained in a gunny sack were soaked in running water for 24 hours. Then the sack was left in the laboratory for another 24 hours. On December 15, 1945, the seeds were sown in the seedbeds, and enough water to saturate the soil was supplied for about one week.

*Transplanting of seedlings.* To soften the soil, the seedbeds were saturated with water. On January 15, 1946, or 30 days after sowing, the seedlings were pulled up from the seedbeds. To reduce transpiration, the tops of the seedlings were pruned two-thirds of their original height.

---

[1]Experiment Station contribution No. 1475. Based on a thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture.

[2]*Hinulipan* refers to vacant hills replanted with either detached tillers or seedlings.

The young plants were set 30×30 centimeters apart in partly irrigated plots or paddies. One seedling was planted to a hill.

A week after the transplanting, 100 plants were selected and were used as mother plants. A bamboo stick one meter long was driven into the soil near the base of each of the selected mother plants. To the upper end of each stick was tied a small tin plate on which was written the plant identification number.

*Care of transplanted seedlings.* For a period of one week after the transplanting, enough water was maintained in the paddies to prevent the drying up of the newly transplanted seedlings and the growth of weeds. As conditions demanded, the paddies were weeded from time to time.

Care was taken to control or minimize the attacks of pests and diseases upon the rice plants. Seen attacking the plants were the rice leaf folder, *Cnaphaleerosis medinalis* Cuenee; the rice bug, *Leptocorisa acuta* Thunberg; and the red rice weaver *Munia atricapilla minuta.* Attacks of the rice folders were observed throughout the vegetative stage of the plants, those of the rice bugs during the milk stage, and those of the red rice weaver during the period of maturity of the grains. No serious damage was done on the cultures.

## EXPERIMENTS AND RESULTS

### *Observations on tillering phase of rice seedlings*

Tillering[3] of the mother plant was observed from time to time and the dates of appearance of tillers were recorded. The first tiller appeared on January 20, 1946, or six days after transplanting. The greatest number of tillers appeared on January 29, 1946, or 14 days after transplanting.

The tillers were transplanted as soon as they were detached from the mother plant, which was 7 to 15 days after the appearance of the tillers. As no work has yet been conducted to serve as guide as to when and how to detach tillers from the mother plant, several trials were made on other plants which were not selected as parent plants. The best results were obtained when the tillers were 7 to 15 days old, for the tillers were then quite large and consequently comparatively easy to detach from the mother plant, and therefore had the best chance to live. Detachment of tillers was stopped beyond the fifteenth day of the tillers because experience showed that detachment at this period, which already was the booting stage, caused the death of the mother plant. Detaching done previous to booting, however, did not show any fatal effect on mother plants.

[3]The tillering phase refers to that period in the life of the mother plants when tillers, including all those that appeared before the booting stage, are produced.

The maximum number of tillers was detached and transplanted on February 26, 1946. At this time the tillers produced and subsequently transplanted were 96.

*Developmental behavior of detached tillers constituting the clonal[4] progeny of each seedling*

Three days after tillers were transplanted, they showed a slight yellowing of the leaves, owing probably to the disturbance of the root system. The growth of the plants was rather slow, and tillering began 8 to 12 days after transplanting. The total number of culms produced by the detached tillers ranged from 2 to 33. The total number of culms produced by the detached tillers was $9.61 \mp 0.21$, but the number of culms produced by the progenies was more variable than that produced by the mother plants. Of the 437 transplanted detached tillers, only 13 died a few days after transplanting. In a few cases, the detached tillers were observed to boot and flower simultaneously with their parents. Most of the detached tillers, however, booted and flowered late, and both the progenies and the parent plants matured later than the undisturbed or control plants.

*Frequency and maximum number of plants that could be established asexually from an individual rice plant*

It was observed that the maximum number of tillers detached from the mother plant before it reached the booting stage varied from 4 to 6. Six tillers were detached from 5 plants, 5 tillers from 27 plants, and 4 tillers from 68 parental clons.

The highest mean total number of culms produced, determined from the first detached tillers was $11.32 \mp 0.531$. The lowest were $7.6 \mp 0.330$ and $7.6 \mp 0.951$ from the fourth and the sixth detached tillers respectively. It was observed also that the number of culms produced by the second detached tiller was the most variable.

Figure 1 shows the distribution of the total number of culms produced by the six detached tillers. It may be seen that the first, second, and third tillers detached had the greatest total number of bearing culms. The highest mean number of bearing culms computed from the different detached tillers was that of the first detached tiller, which was $9.9 \mp 0.413$. The other detached tillers had almost the same mean number of bearing culms, ranging from $6.2 \mp 1.27$ to $7.35 \mp 0.345$.

The mean number of nonbearing culms produced by the different detached tillers varied from $1.9 \mp 0.012$ to $2.06 \mp 0.089$.

[4]The plants produced from the tillers from a single mother plant formed a clon.

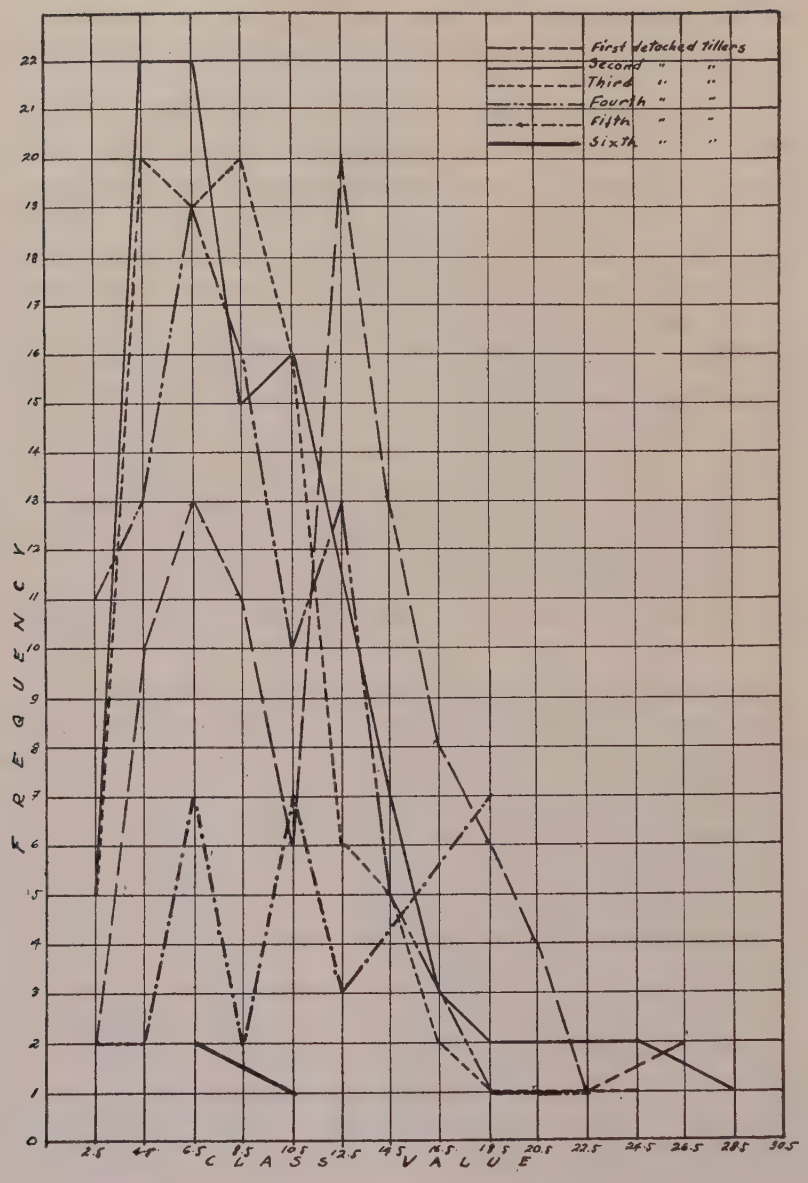


Fig. 1.—Frequency distribution of total number of culms derived from detached tillers.

Figure 2 illustrates the three classes of mother rice plants and their respective progeny which developed from the detached tillers: (*a*) a mother plant which produced three separate individuals representing the least

number, (*b*) one which gave four, representing the average number, and (*c*) one which gave six, the maximum number of tillers detached from the parental clons.

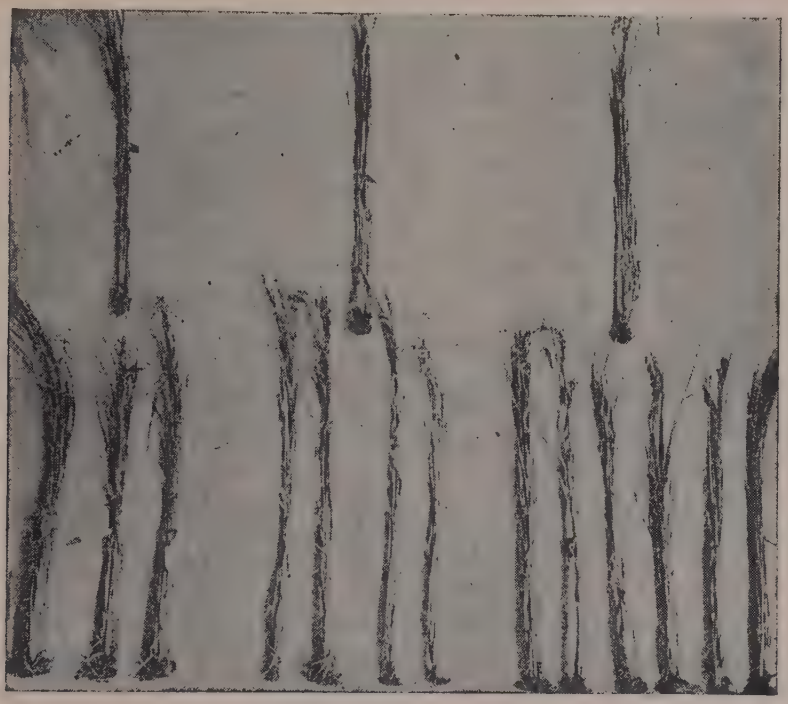

Fig. 2.—Appearance of mature rice plants: left, a mother plant with the least number of tillers detached; middle, a mother plant with the average number of tillers detached; and right, a mother plant with the maximum number of tillers detached.

*Comparison of vegetative and reproductive periods of the asexual progeny as compared with the parent clon*

In rice it appears that coincident with the period of detachment of tillers is the formation of initials of the floral buds so that the detached tillers and the mother clons may be considered to have the same level of floral initial stage. This is corroborated by observations in this study, where the detached tillers and parental clons flowered at the same time. The undisturbed (control) stools flowered and headed earlier than the disturbed plants. Their grains matured on May 10, 1946. The mother clons bloomed and headed at the same time as the progenies. The panicles produced by the clons matured a month later than the control. The grains matured from June 10 to June 15, 1946. Although the period of maturity

was delayed, there was no appreciable change in the shape and color of the grains. This finding indicates that asexual propagation of rice by tillers results in breeding true to type, and for genetic and plant breeding practice, it may well be resorted to for establishment of pure breeding strains.

It was noted that during the vegetative stage, the progenies were more susceptible to the attack of the rice leaf folder. Four mother plants died because tillers were detached from them during the booting stage. The rice plants were attacked by rice bugs during the milk stage.

The parent-progeny correlation indicates the intensity of asexual inheritance of tillering. The coefficient obtained was in reality the coefficient of heredity. The correlation between the number of bearing culms produced by the mother and that by the progeny is positive and highly significant. This means that an increase in the number of bearing culms of the mother is followed by an increase in the number of bearing culms of the detached tillers.

There is a positive correlation between the nonbearing culms produced by the mother clons and those produced by the detached tillers. The correlation is highly significant.

It was found in this study that there is a positive correlation between the total number of culms (including the bearing and nonbearing) produced by parent clons and that by the detached tillers of progenies.

## SUMMARY AND CONCLUSIONS

1. The mother plants began to produce tillers 6 days after transplanting, or 37 days after seeding, and tillering continued even when the plants were in the booting stage.

2. The progenies, or detached tillers, began to produce tillers 8 to 12 days after they had been detached and transplanted.

3. Detachment of tillers from the mother plants in the booting stage caused the death of the mother plants.

4. The maximum number of tiller plants that could be established asexually from an individual mother plant before the latter reached the booting stage ranged from 4 to 6.

5. No morphological and developmental variations were observed accompanying tiller propagation of rice.

6. The coefficient of parent-progeny correlation was positive and significant.

7. Detachment of tillers caused the delay in maturity of the panicles of both the parental clons and the progenies.

8. Under the conditions that existed during this study, rice could be propagated asexually by tillers detached from the mother plants 7 to 15 days after their appearance. The tillers subsequently produced by the

mother plants before the booting stage was reached could likewise be employed for the same purpose.

9. The findings definitely indicate that in the establishment and maintenance of pure strains of rice as a source of seed, the first three tillers of rice plants may be utilized successfully for asexual propagation.

10. It was found feasible to propagate all the tillers in a clon. For "hinulipan" purposes, however, it is not recommended to use more than the first three tillers because of high mortality of the later ones. Furthermore, wholesale removal of the tillers tends to kill parent clons. Moreover, not only is too much additional time needed to wait for the appearance of these later tillers, but also the delay involved would result in loss of a considerable part of the crop because of inability to catch up with the harvest season.

# COST OF PRODUCING GUINEA GRASS, NAPIER GRASS, AND PARA GRASS FOR SOILING IN 1940-1943[1]

José P. Esguerra
*Of the Department of Animal Husbandry*

The raising of grass for soilage by the Department of Animal Husbandry is an important project because of the need for horse feed, the gradual increase of the dairy animals, and the inadequate pasture areas available for them to graze on. The area allotted to these animals can not be increased because the management of the animals in the other herds will be greatly affected. In order, therefore, to remedy the forage shortage necessary for their maintenance, grasses are raised for soilage.

The grasses grown in the department for soiling purposes are guinea grass (*Panicum maximum* Jacq.), napier grass (*Pennisetum purpureum* Schum.), para grass (*Panicum barbinode* Trin.), guatemala grass (*Tripsacum laxum* Nash), and Japanese cane (*Saccharum japonicum*). The first three grasses were used in this study.

According to Jacobson (1914) guinea grass was introduced from Hawaii into the Philippines in 1907. An experiment conducted by the Bureau of Agriculture in 1908 produced 71,810 kilograms per hectare in 183 days. Another experiment (Anon., 1909) produced 50 tons per hectare in one cutting on an area which had not been irrigated but had been frequently cultivated. Villegas (1935) found that guinea grass planted 75 cm. × 90 cm. and harvested when the flowers were beginning to appear produced 26,216.9 kgm. the first year; when planted one meter apart the yield was 43,700.8 kgm. per hectare. Higginbotton (1937) found that the yield of guinea grass was 60 to 70 tons per acre (148 to 173 tons per hectare) and that of napier grass was 100 tons per acre (247 tons per hectare). Galang and Paulino (1925) pointed out that napier grass was introduced into the Philippines from Hawaii in 1918, and para grass from Ceylon in 1910 by the Bureau of Agriculture. Pepa (1927) cut guinea grass when it was 30 to 80 cm. high and napier grass when it was 100 to 175 cm. high. Villegas (1936) planted napier grass one meter by one meter apart and harvested it when it was about 120 cm. high, or when the plants were moderately fibrous and juicy and scattered plants were in bloom. The yield was 59,656.4 kgm. per hectare. According to Wing (1911) para grass grows well on moist land and

[1]Experiment Station contribution No. 1476.

when planted in prepared soil during the dormant season, takes root and sends out long runners that lie close to the ground. When the ground is covered with leafy runners, upright stems appear. Piper (1924) pointed out that para grass is a tropical plant and is adapted to wet or moist land; it is difficult to eradicate. It is usually cut when two to three feet high.

The object of this study was to determine the cost of producing guinea grass, napier grass, and para grass for a period of three years. The work was conducted in the Department of Animal Husbandry, College of Agriculture, University of the Philippines, from June 3, 1940, to September 25, 1943.

### LAND

A piece of land located in one corner of the grounds of the department was selected for the culture. It was dressed with horse, cattle, and carabao manure at the rate of 82,500 kgm. per hectare before plowing. Three lots of 2,000 sq. m. each were measured, and one lot was devoted to each grass. The land was evaluated at ₱250 per hectare, and the rent at ₱30 a year. The whole area was plowed once before the rainy season.

### LABOR

Laborers of the Department of Animal Husbandry were employed in the plowing, harrowing, planting, cultivation, and harvesting. Their wages ranged from ₱1 to ₱1.55 a day.

### WORK ANIMALS

Grade Murrah work animals were used in the preparation of the ground, in the furrowing, and in the cultivation. Their wage was fifty centavos a day.

### PLOWS AND HARROW

Locally made plows and a harrow were used in the preparation and cultivation of the area. The cost of the plows was ₱27 each and of the harrow ₱2. The implements were calculated to last 2.5 years when used 150 days in one year. The plow was used 31.5 days during the experiment: 12 days in the first year, 11 days in the second, and 8.5 days in the third.

### BULL CARTS

One bull cart was used in hauling the grass from the field to the barn during the harvest time. The cost was ₱90. It was calculated to last 4 years when used 150 days a year. It was used for 30 days in this experiment: 12 days in the first year, 9 days in the second, and 9 days in the third.

### SCALE

One Fairbanks scale of 750-kgm. capacity and costing ₱136 was used in the weighing of grasses. It was calculated to last 10 years when used

daily. It was used for 30 days in this study: 12 days in the first year, 9 days in the second, and 9 days in the third.

### PLANTING MATERIALS

The napier grass cuttings, and the guinea and para grass stools were produced in the Department of Animal Husbandry. The cost per hectare in each case was estimated at ₱30.

### CULTURES

Three men and three work animals were used to plow and harrow the three lots on June 3, 1940.

#### *Guinea grass*

On July 1, 2, and 3, 1940, two men at a time were assigned to prepare the stools for planting. One man and one carabao made the furrows for one-half day on July 4, and four men planted the root stocks in the afternoon for three hours. The area was cultivated five times in the first year, three times in the second, and twice in the third, using one man and a carabao each time.

#### *Napier grass*

On July 5, 1940, the napier grass was planted. While one man and one carabao made the furrows, three men prepared the cuttings and another three men were detailed to plant. The area was cultivated four times in the first year, twice in the second, and once in the third, using one man and one carabao each time.

#### *Para grass*

On July 6, 1940, the para grass was planted. One man and a carabao made the furrows for one-half day, four men prepared the stools for one-half day, and three men planted the grass for one day. The area was cultivated three times during the first year, twice in the second, and twice in the third year, using one man and a carabao each time.

### HARVESTING

The grasses were cut when the stems were moderately fibrous and sufficiently tender.

#### *Guinea grass*

The grass was harvested six times the first year, four times the second, and five times the third. The cutting was done when a few scattered plants in the rows were in bloom. At this stage the grass was from 60 to 100 cm. high. The work lasted for 366 days in the first year, 346 days in the second, and 421 days in the third.

*Napier grass*

The harvesting was done four times the first year, three times the second, and six times the third. The cutting was done when the grass was moderately fibrous and juicy. The height of plants ranged from 120 to 210 cm. The time covered by the work was 364 days in the first year, 364 days also in the second, and 428 days in the third.

*Para grass*

The grass was harvested four times in the first year, three times in the second, and four times in the third. As with the guinea grass, harvesting was done when a few scattered plants in the area were in bloom. The length of the stems ranged from 90 cm. to 100 cm. The study lasted 371 days in the first year, 375 days in the second, and 396 days in the third.

## RESULTS

*Cost of raising guinea grass, napier grass, and para grass*

Table 1 shows the cost of growing the three grasses in three years.

*Periodical and total harvest for three years of guinea grass, napier grass, and para grass*

Table 2 indicates the grass production for three years.

It may be noted in table 2 that in spite of the fact that the area was top-dressed with manure at the start of the work, there was a decline in production from the first year to the third. The very low production of the grasses in the second year was due to unfavorable weather conditions during the year.

## SUMMARY

1. The cost of raising the three grasses in three years are as follows:

| | FIRST YEAR | SECOND YEAR | THIRD YEAR |
|---|---|---|---|
| Guinea grass | ₱50.33 | ₱19.71 | ₱33.44 |
| Napier grass | ₱47.50 | ₱16.75 | ₱50.90 |
| Para grass | ₱79.64 | ₱23.57 | ₱44.50 |

2. The yield of the three grasses in three years are as follows:

| | FIRST YEAR | SECOND YEAR | THIRD YEAR |
|---|---|---|---|
| Guinea grass | 15,895 kgm. | 5,489 kgm. | 9,686 kgm. |
| Napier grass | 28,367 kgm. | 7,233 kgm. | 13,656 kgm. |
| Para grass | 22,552 kgm. | 10,043 kgm. | 17,311 kgm. |

3. The yield of guinea grass per hectare was 51,785 kgm.; napier grass, 81,910 kgm.; and para grass, 83,175 kgm.

4. The cost of producing 1,000 kgm. of guinea grass was ₱3.32; napier grass, ₱2.34; and para grass, ₱2.96.

5. The yield of guinea grass, napier grass, and para grass was higher in the first year than in the second and third years.

LITERATURE CITED

ANON. 1909. Report of the Bureau of Agriculture for the fiscal year ending June 30, 1909. Philippine Agric. Rev. **2**: 16.

GALANG, F. G., AND P. L. PAULINO. 1925. A progress report on forage crop investigation at the Lanao Experiment Station. Philippine Agric. Rev. **18**: 3 and 7.

HIGGINBOTTON, SAM. 1937. More and better milk. Allahabad Farmer **11**: 64.

JACOBSON, H. O. 1914. Guinea grass. Philippine Agric. Rev. **2**: 16.

PEPA, MAXIMO E. 1927. A comparative study of the palatability of some common Philippine forages. Philippine Agriculturist **15**: 550.

PIPER, CHARLES V. 1924. Forage plants and their culture. Rev. ed.

VILLEGAS, VALENTE. 1935. Seasonal yield and productive life of Guinea grass (*Panicum maximum* Jacq.) for soiling purposes. Philippine Agriculturist **23**: 742–743.

VILLEGAS, VALENTE. 1936. The yield and productive life of napier grass (*Pennisetum purpureum* Schum.) as soilage crop for farm animals. Philippine Agriculturist **25**: 472–473.

WING, JOSEPH E. 1911. Meadows and pasture. 418 p.

TABLE 1

*Labor cost of raising guinea grass, napier grass, and para grass for three years*

| OPERATIONS | GUINEA GRASS | | | NAPIER GRASS | | | PARA GRASS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year | | | Year | | | Year | | |
| | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| | *pesos* | *pesos* | *pesos* | *pesos* | *pesos* | *pesos* | *pesos* | *pesos* | *pesos* |
| Plowing | 1.54 | — | — | 1.53 | — | — | 1.53 | — | — |
| Planting | 8.47 | — | — | 8.15 | — | — | 6.35 | — | — |
| Cultivation | 8.34 | 4.25 | 3.00 | 6.08 | 3.50 | 1.25 | 6.58 | 3.25 | 3.00 |
| Harvesting | 18.75 | 8.83 | 23.69 | 18.56 | 6.46 | 42.21 | 52.16 | 13.77 | 34.75 |
| Depreciation of: | | | | | | | | | |
| Plows and harrow | 0.44 | 0.24 | 0.16 | 0.40 | 0.20 | 0.16 | 0.24 | 0.16 | 0.16 |
| Bull cart | 0.30 | 0.30 | 0.45 | 0.75 | 0.45 | 0.80 | 0.60 | 0.30 | 0.45 |
| Scale | 0.18 | 0.09 | 0.14 | 0.23 | 0.14 | 0.18 | 0.18 | 0.09 | 0.14 |
| Land rent | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| Cost of cuttings | 6.00 | — | — | 6.00 | — | — | 6.00 | — | — |
| Total expenses | 50.02 | 19.71 | 33.44 | 47.70 | 16.75 | 50.60 | 79.64 | 23.57 | 44.50 |
| Expenses for three years | | 103.17 | | | 115.05 | | | 147.71 | |
| Average expenses a year | | 34.39 | | | 38.35 | | | 49.24 | |

TABLE 2

*Grass production for three years*

| NO. OF HARVESTS | FIRST YEAR | SECOND YEAR | THIRD YEAR | TOTAL PRODUCTION | AV. PRODUCTION PER HA. YEAR |
|---|---|---|---|---|---|
| | *kgm.* | *kgm.* | *kgm.* | *kgm.* | *kgm.* |
| | | *Guinea grass* | | | |
| First | 4,988 | 2,287 | 1,492 | | |
| Second | 3,538 | 604 | 2,565 | | |
| Third | 3,750 | 650 | 1,119 | | |
| Fourth | 1,134 | 1,948 | 2,209 | | |
| Fifth | 960 | — | 2,301 | | |
| Sixth | 1,525 | — | — | | |
| Total | 15,895 | 5,489 | 9,686 | 31,070 | 51,783 |
| | | *Napier grass* | | | |
| First | 7,448 | 2,971 | 2,887 | | |
| Second | 9,594 | 600 | 1,103 | | |
| Third | 3,203 | 3,662 | 2,328 | | |
| Fourth | 8,122 | — | 475 | | |
| Fifth | — | — | 1,616 | | |
| Sixth | — | — | 5,247 | | |
| Total | 28,367 | 7,233 | 13,656 | 49,256 | 82,093 |
| | | *Para grass* | | | |
| First | 10,195 | 3,482 | 3,076 | | |
| Second | 7,170 | 1,569 | 2,148 | | |
| Third | 1,557 | 4,992 | 2,746 | | |
| Fourth | 3,630 | — | 9,341 | | |
| Total | 22,552 | 10,043 | 17,311 | 49,906 | 83,177 |

# THE INFLUENCE OF DIFFERENT KINDS OF ANIMAL MANURE ON THE YIELD OF THE EGGPLANT[1]

VICENTE M. DAWIS AND FEDERICO L. LABIS
*Of the Department of Agronomy*

The work reported in this paper was conducted from October 2, 1946, to April 20, 1947, at the Experiment Station field and in the laboratory of the Department of Agronomy, College of Agriculture, Los Baños, Laguna, to determine the influence of different kinds of animal manure on the yield of the eggplant.

*Review of literature*

For high yield in eggplants, Johnson and Miller (1914) found a need for supplying liberal quantities of stable manure in addition to the usual application of commercial fertilizers.

Parker (1926) stated that while most sandy soils are suitable for eggplant culture, they are usually deficient in organic matter, so that for good results considerable stable manure must be added. Villegas, Ynalvez, and Elefaño (1937), in connection with their study on the fertilizing constituents of the solid excreta of Philippine cattle reported the chemical analysis of the feces as follows: $H_2O$, 82.1 per cent; $N_2$, 0.27 per cent; $P_2O_5$, 0.41 per cent; $K_2O$, 0.20 per cent; and CaO, 0.27 per cent. That of Nellore contained 82.5 per cent of $H_2O$, 0.28 per cent of $N_2$, 0.30 per cent of $P_2O_5$, 0.15 per cent of $K_2O$, and 0.35 per cent CaO.

Villegas and Ynalvez (1937) reported that the different amounts of plant nutrients in the solid excreta of Philippine carabaos were as follows: $H_2O$, 82.9 per cent; $N_2$, 0.27 per cent; $P_2O_5$, 0.63 per cent; $K_2O$, 0.14 per cent; and CaO, 0.17 per cent. They also reported for the sheep 64.8 per cent $H_2O$, 0.75 per cent $N_2$, 1.48 per cent $P_2O_5$, 0.87 per cent $K_2O$, and 0.86 per cent CaO; for the goat, 65.1 per cent $H_2O$, 0.92 per cent $N_2$, 1.51 per cent $P_2O_5$, 0.56 per cent $K_2O$, and 0.59 per cent CaO.

---

[1]Experiment Station contribution No. 1477. This paper is based on a thesis presented by the junior author for graduation from the College of Agriculture with the degree of Bachelor of Science in Agriculture, June, 1947.

Morrison (1936), working under conditions obtaining in the United States, reported for different animals the following percentage of constituents:

| | $H_2O$ | $N_2$ | $P_2O_5$ | $K_2O$ |
|---|---|---|---|---|
| Horse | 59 | 0.70 | 0.11 | 0.64 |
| Dairy cattle | 79 | 0.57 | 0.10 | 0.52 |
| Fattening cattle | 78 | 0.73 | 0.21 | 0.64 |
| Sheep | 64 | 1.44 | 0.22 | 1.01 |
| Swine | 74 | 0.49 | 0.15 | 0.39 |
| Hens (without litter) | 55 | 1.00 | 0.35 | 0.33 |

The average composition of fresh manure, including both solid and liquid, as reported by Thompson (1938) follows:

| | $H_2O$ *per cent* | $N_2$ *per cent* | $P_2O_5$ *per cent* | $K_2O$ *per cent* |
|---|---|---|---|---|
| Sheep | 64 | 0.83 | 0.23 | 0.67 |
| Horse | 70 | 0.58 | 0.28 | 0.53 |
| Pig | 73 | 0.45 | 0.19 | 0.60 |
| Cow | 77 | 0.44 | 0.16 | 0.40 |
| Chicken | 55 | 1.00 | 0.80 | 0.40 |

Galvez and Romero (1941) reported the beneficial effects on pe-tsai of various kinds of compost prepared out of rice straw in combination with different kinds of animal manure.

## MATERIALS AND METHODS

### *Materials*

*Variety of eggplant.* The variety used in this study was the Native Long Purple. The seeds were taken from selected, fully ripened fruit in the vegetable garden of the Department of Agronomy.

*Animal manures and other fertilizers.* All farm manures used were taken from the stables of the Department of Animal Husbandry, the bat guano from the ceiling of the Administration Building, and the rice straw, from Calamba, Laguna. Ammonium sulfate was supplied by the Department of Agronomy.

*Soil.* The soil was Lipa clay loam taken from the poultry yard of the Department of Animal Husbandry.

### *Methods of culture*

*Preparation of the mixture.* On July 25, 1946, the farm manures, which were of about the same degree of freshness, were collected from the stable of the Department of Animal Husbandry and separately dried. Each kind was then mixed with garden soil in the proportion of 3/4 well-pulverized garden soil and 1/4 well-dried manure. The mixture was passed

through a 0.7 cm.-mesh sieve, placed under a shed, watered from time to time, and stirred every five days until there was no longer any heat of fermentation. The same procedure was followed with the bat guano and rice straw. Ammonium sulfate dissolved in water was applied at the rate of 2.8 grams to a plant.

*Preparation of holes.* On November 27, 1946, about 350 square meters of land was divided into five blocks, each block composed of ten rows one meter apart, and representing a treatment or a different kind of manure of ten replications. For this purpose 500 holes, each measuring 25 centimeters square, were made in rows one meter apart. The distance between holes was 60 centimeters. The treatments were randomized.

*Sowing of the seeds.* The soil for germination was sterilized by heating it on a piece of galvanized iron sheet. The seeds were sown in a seed box on October 2, 1946. The seeds were protected from ants and the soil was kept moderately moist.

*Pricking.* On November 1, 1946, 30 days after sowing, when the seedlings were about five centimeters high, they were pricked eight centimeters each way to give them more space for proper development. They were shaded with banana leaves. Ten days later, the seedlings were gradually exposed to the sun to harden them.

*Application of the mixture.* On November 28, 1946, the holes which had been prepared previously were filled with the soil-manure mixture.

*Transplanting.* One day before the seedlings were transplanted to the field, the seed boxes were watered thoroughly to soften the soil, to facilitate removal of the seedlings, and to minimize root injury. Only vigorous and healthy seedlings were selected for transplanting. They were planted early in the morning and late in the afternoon of November 29, 1946, 56 days after sowing. The seedlings that were planted in the morning were watered immediately and covered with pieces of banana bracts to prevent excessive drying, and those that were planted late in the afternoon were covered the following morning. Each set included ten plants, or a total of 500 plants for the five replications. Five days after the seedlings had been set in the field, the missing hills were replanted.

*Cultivation.* Ten days after the seedlings had been set in the field, they were cultivated with a garden hoe. Subsequent cultivations were done when the soil became compact and weeds plentiful.

*Weeding.* The weeds were removed with a garden hoe and the soil around the plants hilled up after each cultivation. Weeding was done from time to time until the eggplants were about to flower.

## RESULTS AND DISCUSSION

### *Field observations*

The plants treated with pig manure were the slowest to recover from the effects of transplanting. When all the rest showed distinct signs of recovery after the first week of transplanting, those in the pig manure treatment were still slightly yellowish and clearly showed marks of disturbance. After the second week were noticed marked differences not only in intensity of the green coloring of the leaves but also in size of the plants. In general, the plants in the same treatment were more or less the same as regards the color of the leaves and the size of the plants. Selected on the basis of the size and vigor of the plants, those that were treated with ammonium sulfate, chicken manure, goat manure, horse manure, and bat guano were the best, ranked in the descending order of superiority. The control plants were poorest, and the plants that received a mixture of pig manure and soil, second poorest. On the third week, the treatments found to be the best, on the basis of the same criterion, were ammonium sulfate, chicken manure, goat manure, horse manure, and bat guano. In all cases, all plants in the treated lots were better than those in the control lot. On the fourth week, the indications were that the best were chicken manure, goat manure, and horse manure, although ammonium sulfate was still better than any of the three.

The plants were attacked by pests and diseases but the damage done was negligible.

*Period from sowing to flowering.* The plants in the different treatments began flowering on January 7, 1947, or 95 days after sowing. By January 30, 1947, most of the plants in all treatments had flowered. The analysis of variance shows that certain plant groups in the different treatments varied significantly, depending on the fertilizer used. The earliest flowering plants were those fertilized with ammonium sulfate; their mean number of days from the date of sowing was 99.72. The next earliest group was formed by plants that were fertilized by chicken, horse, goat, or bat manure. The plants in this group yielded less than the ammonium sulfate-fertilized ones but did not vary significantly among each other within the group.

A third group was formed by plants fertilized with the following: cow manure, which averaged 104.20 days from sowing to flowering; rice straw compost, 104.72 days; carabao manure, 105.66 days; and pig manure, 106.10 days. As in the second group, none of the treatments yielded significantly more than any other in the group. They yielded, however, significantly less than the preceding group. The control lot yielded significantly less than any of the treated lots.

*Flower setting to the time when the fruit was ready for market.* Contrary to expectations, earliness in flowering did not result in early development of marketable fruit perhaps because most of the earlier formed flowers did not set. The analysis of variance shows that duration of development of the marketable fruit from flower setting is not significant.

*Comparison of yields of different treatments.* The different fertilizer treatments influenced the yield of the eggplant significantly. The least significant mean difference was found to be 298.0 grams. Forming a group of the highest yielders were ammonium sulfate, with an average yield of 2954.7 grams; chicken manure, 2809.4 grams; and goat manure, 2767.0 grams. These three treatments are a group by themselves, yielding significantly more than any other group but not differing significantly from one another within the group. Similarly, a second group may be formed with treatments resulting in a yield significantly less than the preceding group but significantly more than a third. The fertilizers forming the second group are horse manure, 2594.8 grams; bat guano, 2594.7 grams; and carabao manure, 2248.1 grams. As in the preceding group, they do not vary significantly within the group. The third group, which may be designated as yielding the least, is composed of rice straw compost, 2078.4 grams; cow manure, 2091.7 grams; pig manure, 2038.8 grams; and control, 1796.3 grams. It may be seen that the control yielded the least of all treatments although not significantly less than the rest in the group of lowest yielders.

## SUMMARY

1. Observation of the seedlings after the first week of transplanting did not show noticeable differences among the various treatments.

2. From the beginning of the third to the fourth week, marked differences could be observed in the color of the leaves, vigor, and to some extent, the size of the plant. Selected on the basis of size and vigor of the plants, those that were treated with ammonium sulfate at the rate of 2.8 grams a plant, chicken manure, goat manure, horse manure, and bat guano at the rate of 1/4 by volume a plant were found to be the best, ranked in the descending order of superiority.

3. The length of time from sowing to flowering differed significantly among the treatments. Earliest to flower was the lot treated with ammonium sulfate with a mean of 99.72 days. Second earliest were those treated with chicken manure, with a mean of 102.14 days; horse manure, 103.14 days; goat manure, 103.22 days; and bat guano, 103.26 days. The third group consisted of plants treated with cow manure, 104.20 days; rice straw compost, 104.72 days; carabao manure, 105.66 days; and pig manure, 106.10

days. The control plants flowered significantly the latest, that is, 108.12 days after sowing.

4. The period from flower setting to the time when the fruit was ready for market use was not influenced by the application of the different kinds of animal manure.

5. The different treatments significantly affected the yield of the eggplant. Ammonium sulfate gave the highest yield of 2954.7 grams, followed closely but with no significant difference by chicken manure, 2809.4 grams; and goat manure, 2767.0 grams. Forming a group of second highest yielders were horse manure, 2594.8 grams; bat guano, 2594.7 grams; and carabao manure, 2248.1 grams. Forming a third group were cow manure, 2091.7 grams; rice straw compost, 2078.4 grams; pig manure, 2038.8 grams; and control, 1796.3 grams.

LITERATURE CITED

GALVEZ, N. L., AND I. A. ROMERO. 1941. Study on the preparation of compost from rice straw. Philippine Agriculturist 29: 753–763.

JOHNSON, T. C., AND F. C. MILLER. 1914. The home vegetable garden. Virginia Dept. of Agriculture and Immigration (Norfolk, Virginia) Bull. 10: 241–242.

MORRISON, F. B. 1936. Feeds and feeding. 20th ed. vi+1050p. Ithaca, New York: The Morrison Publishing Co.

PARKER, M. M. 1926. Eggplant culture. Virginia Truck Experiment Station (Norfolk, Virginia) Bull. 55: 480–487.

THOMPSON, H. C. 1939. Vegetable crops. 5th ed. xi+578p. New York: McGraw-Hill Book Company, Inc.

TABLE 1

*Average number of days from sowing to flowering, from flower setting to maturity, and average yield per plant of different treatments*

| TREATMENTS | AVERAGE NUMBER OF DAYS FROM SOWING TO FLOWERING | AVERAGE NUMBER OF DAYS FROM FLOWER SETTING TO MATURITY | AVERAGE YIELD PER PLANT |
|---|---|---|---|
| | | | *grams* |
| Chicken manure | 102.14 | 16.8 | 2809.4 |
| Carabao manure | 105.66 | 17.1 | 2248.1 |
| Cow manure | 104.20 | 17.0 | 2091.7 |
| Horse manure | 103.14 | 16.8 | 2594.8 |
| Goat manure | 103.22 | 16.3 | 2767.0 |
| Pig manure | 106.10 | 17.4 | 2038.8 |
| Bat guano | 103.26 | 17.0 | 2594.7 |
| Rice straw compost | 104.72 | 18.0 | 2078.4 |
| Ammonium sulfate | 99.72 | 17.0 | 2954.7 |
| Control | 108.12 | 18.6 | 1796.3 |

# THE PERFORMANCE OF THREE VARIETIES OF RICE WHEN PLANTED LATE IN THE SEASON[1]

RUFO H. OCFEMIA AND VALERIANO C. CALMA
*Of the Department of Agronomy*

The performance of Seraup Kechil 36, Apostol, and Inintiw when planted late in the season[2] were determined in a study conducted from July, 1945, to March, 1946, in the Experiment Station rice fields and in the laboratory of the Department of Agronomy, College of Agriculture, Los Baños, Laguna.

Of the three varieties used, Seraup Kechil 36, a lowland rice, is the highest yielder. Inintiw, under lowland conditions, has given a fairly good yield when planted late in the season. As Apostol, which matures in 140 to 150 days, has never been tried under Los Baños conditions, it was included in the study for comparison with the other two varieties.

Camus (1921) reports that Inintiw matures in 123 days and gives a yield of 45.7 cavans a hectare. Abesamis (1922) found that the time of transplanting and the amount of rainfall influence the yield. Borja and Torres (1930) noted that Inintiw matures within 120 days, gives a fair yield, and is commonly planted broadcast in the upland fields of Los Baños. When used as a secondary crop in the lowland rice fields of the College, Inintiw was found by Calma and Palis[3] to mature in 117 days after the seeds are broadcast and gives an average yield of 20.63 cavans a hectare.

Of the ten varieties of rice imported from the Federated Malay States, Aragon and Cada (1939) found that Seraup Kechil 36 is one of the highest yielders and the most promising for the Philippines. In the first year it required 169 days to mature, and in the second year, 175 days. It yielded, on the average, 68.83 cavans to the hectare. Two years later Calma and Cada (1941) reported that Seraup Kechil 36 matures in 182 days after it is sown in the seedbed and gives a yield of 64.5 cavans per hectare.

---

[1]Experiment Station contribution No. 1478, presented by the senior author as thesis for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, May, 1946.

[2]"Late in the season" refers to the period past the regular planting time. In the rice fields of the College of Agriculture the usual time for sowing the seeds in the seedbed is from the later part of June to the later part of July and that for transplanting in the field is from August to about the first week of September.

[3]CALMA, VALERIANO C., AND NORBERTO C. PALIS. Inintiw and Sinariaya as secondary crops in succession to a primary rice crop. (In press).

Casa[4] states that Apostol matures in 144 days and gives a yield of 35 to 65 cavans a hectare. He recommends it for planting in unirrigated lowland rice fields.

## EXPERIMENT, RESULTS, AND DISCUSSION

Seraup Kechil 36 was obtained from San Antonio, Los Baños, Laguna. Apostol from the Philippine Bureau of Plant Industry, and Inintiw from Raymundo Barrio, Los Baños. In a germination test Seraup Kechil 36 gave 96 per cent germination, Apostol 93 per cent, and Inintiw 95 per cent.

A 4,500-square-meter portion of the clay loam lowland rice field of the College Experiment Station was used. The land had been planted to rice continuously every year but was fallowed after the harvest of the rice crop in February, 1945. Fifteen rectangular paddies numbered consecutively from 1 to 15, and 300 square meters each, were prepared to allow five replications for each variety and arranged at random to allow analysis of variance.

On August 10, 1945, the seeds in separate gunny sacks were soaked in running water for 24 hours and placed in a shady place for 48 hours to sprout them. The sprouting seeds were sown on August 13, 1945, at the rate of 20 gantas to every 500 square meters in beds prepared by the ordinary wet-bed method. Germination was completed a week after sowing. When the seedlings were about a month old, Inintiw was decidedly taller than the other two, and some of the plants already had nodes formed.

On September 26, 1945, the 46-day-old seedlings were pulled, tied in small bundles, and the upper one-third of the seedlings were pruned. Two to three seedlings were planted in each of hills about 25 centimeters apart, in paddies prepared in the usual way.

On October 25, 1945, 27 days after transplanting, an unusually early booting was noted in plots I, II, V, and XV of Inintiw. The panicles, however, were dry and the grains empty. As Inintiw was transplanted 46 days after sowing in the seedbed for lack of water and of work animals, it produced an uneven growth, and at the time of transplanting some of the seedlings already had nodes.

As the plants approached maturity, Seraup Kechil 36 lodged the most, owing probably to the increase in weight of the grains of the panicles. Apostol lodged also shortly before it was harvested; whereas Inintiw did not lodge at all.

As soon as culms were formed and until the grains were past the dough stage, the rice-stem borer, *Schoenobius incertellus* Wlk., was injurious.

[4]Casa, Juan C. 1946. Increase your rice yield by planting choice varieties. Plant Industry Digest (Manila) 9 (1): 7–10.

The rice bugs (*Leptocorisa acuta* Thunberg) were numerous when the grains were in the milk stage. The stem borer caused the appearance of dried panicles with empty grains; whereas the rice bug was responsible for the empty grains in some panicles.

As the grains approached the dough stage and until they matured, the rice weaver, *Lonchura ferruginosa jagori*, fed on the grains. The use of scarecrows to minimize the damage caused by these birds was not effective. In addition to the rice weaver, bats and rats caused considerable damage to the crop. The loss of entire panicles of rice was attributed to bats because the panicles were cut at a point very close to the grains and too high for the rats to reach. Abesamis (1922) attributed to rats the toppling over of some of the stalks of rice in his culture.

The damage from birds and other pests was greatest in plots of Inintiw, followed by those of Apostol, because these varieties attained the milk, dough, and glazing stages at about the same time. Furthermore, these two varieties were the only rice that flowered and matured at that time in the vicinity. Perhaps Seraup Kechil 36 was the least affected because the greater part of the rice crop in the surrounding fields was maturing at the same time as this variety.

In regard to diseases, only false smut caused by *Ustilaginoidea virens* (Cke.) Tak. infected some of the grains of the panicles, but its damage was negligible.

In height of plants Seraup Kechil 36, Apostol, and Inintiw differed significantly. Seraup Kechil 36 was the tallest, with a mean height of 137.79 centimeters; Apostol ranked second, with a mean height of 113.59 centimeters; and Inintiw, the lowest, with 99.33 centimeters.

In number of bearing culms, Inintiw with a mean of 12.6 in a hill produced the least, and Seraup Kechil 36, with a mean of 17.6, the greatest. Apostol had a mean of 16.7 bearing culms a hill.

Inintiw flowered in 83.2 to 99.2 days and matured in 129.2 to 140.2 days after sowing in the seedbed; Apostol flowered in 94.4 days and matured in 121.4 days; and Seraup Kechil 36 flowered in 133.2 days and matured in 163.4 days.

In regard to yield, table 1 shows that Seraup Kechil 36 gave a mean yield of 54.68 kilograms from five plots of 300 square meters each; Apostol, 17.06 kilograms; and Inintiw, 1.9 kilograms only. An analysis of variance showed that the difference between their yields is highly significant. Based on 44 kilograms to a cavan, the computed yield of one hectare of Seraup Kechil 36 is 41.40 cavans; Apostol, 12.92 cavans; and Inintiw, 1.44 cavans. For Inintiw this yield is much lower than that obtained by Calma and

Palis,[5] who reported 20.63 cavans a hectare in the lowland rice fields of the College. That Seraup Kechil 36 gave the highest yield may be attributed partly to its production of significantly more tillers to a hill than either of the two varieties. Also, the bending of the panicles and the lodging of Seraup Kechil 36 at maturity indicate that it produced heavier panicles than either Apostol or Inintiw. Furthermore, Seraup Kechil 36 sustained less damage from pests than Apostol or Inintiw because it matured at about the same time as the other rice crops in the surrounding fields. The writers attribute the low yield of Inintiw to various causes. One of these is that the seedlings were transplanted 46 days after sowing in the seedbed. The transplanting seemed too late for Inintiw because some of the plants already had nodes. Escarrilla[6] found that the yield of Seraup Kechil 36 decreased as the transplanting time was delayed and that the best age to transplant was 20 to 30 days after sowing in the seedbed. Bautista[7] reported that the yield decreases if the rice seedlings are transplanted after they have produced nodes. The production of the least number of culms in the stool was probably due to the fact that the plants already had nodes when transplanted. Another probable reason for the low yield of Inintiw and of Apostol was that the pests concentrated their attack on these varieties because they were the only rice maturing at that time.

For comparative purposes is shown below the yield obtained by the writers and the data on the yields of Apostol and Seraup Kechil 36 grown by College tenants in the adjacent fields:

| TENANTS | VARIETY USED | AREA PLANTED *sq. m.* | ACTUAL YIELD *cavans* | COMPUTED YIELD A HECTARE *cavans* |
|---|---|---|---|---|
| Tomas Payas | Apostol | 11,700 | 1.90 | 1.79 |
| Ambrosio Cangao | Seraup Kechil 36 | 2,700 | 3.50 | 12.96 |
| Fernando Palis | Seraup Kechil 36 | 13,200 | 16.80 | 12.72 |
| Rufino Malihan | Seraup Kechil 36 | 9,000 | 8.00 | 8.80 |
| The writers | Apostol | 1,500 | 1.93 | 12.92 |
| | Inintiw | 1,500 | 0.22 | 1.44 |
| | Seraup Kechil 36 | 1,500 | 6.21 | 41.40 |

The data indicate that the writers obtained much higher yields from Seraup Kechil 36 and Apostol than the neighboring farmers. In one case a tenant obtained only 1.79 cavans a hectare of Apostol.

---

[5] CALMA AND PALIS, *op. cit.*

[6] ESCARILLA, AGUSTIN. The effect of age of transplanting seedlings upon the yield of Seraup Kechil 36 rice. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1941. Unpublished).

[7] BAUTISTA, B. R. 1935. The general practice of lowland rice farming on irrigated areas in Central Luzon. Agric. Indust. Monthly 3: 3, 13, 31.

Seraup Kechil 36, with 67 per cent, gave the highest percentage of milling, followed by Apostol with 65.9. Inintiw had the least, with 62.6 per cent.

## SUMMARY

1. When planted late in the season Seraup Kechil 36, Apostol, and Inintiw differed significantly in height. Seraup Kechil 36 had a mean height of 137.79 centimeters, Apostol, 113.59, and Inintiw, 99.33.

2. In number of bearing culms to a hill, Seraup Kechil 36 had a mean of 17.6; Apostol, 16.7; and Inintiw, 12.6.

3. Inintiw suffered the most from pests, and Seraup Kechil 36 the least. Seraup Kechil 36 lodged heavily, Apostol slightly, and Inintiw not at all.

4. Inintiw flowered in 83.2 to 99.2 days and matured in 129.2 to 140.2 days after sowing in the seedbed; Apostol flowered in 94.4 and matured in 121.4 days; and Seraup Kechil 36 flowered in 133.2 and matured in 163.4 days.

5. The three varieties varied very significantly in their yields. Seraup Kechil 36 gave a mean yield of 54.68 kilograms from five plots of 300 square meters each, or 41.40 cavans a hectare; Apostol, 17.06 kilograms or 12.92 cavans; and Inintiw, 1.9 kilograms or 1.44 cavans.

6. Seraup Kechil 36 gave a milling percentage of 67, Apostol 65.9, and Inintiw 62.2.

7. The results seem to suggest that in the College of Agriculture, if rice is to be planted late in the season, Seraup Kechil 36 should be preferred to either Apostol or Inintiw.

## LITERATURE CITED

Abesamis, A. P. 1922. Effect of time of planting on growth and yield of lowland rice in Peñaranda, Nueva Ecija, and on the College farm. Philippine Agriculturist **10**: 381–392.

Aragon, V., and E. Cada. 1939. A preliminary report on the performance of ten rice varieties from the Federated Malay States. Philippine Agriculturist **27**: 625–646.

Borja, V., and J. P. Torres. 1930. Fertilizer experiments on lowland rice. Philippine Jour. Agric. **1**: 247–271.

Calma, V. C., and E. Cada. 1941. Comparative test of six varieties of rice. Philippine Agriculturist **30**: 548–554.

Camus, J. S. 1921. Rice in the Philippines. Philippine Agric. Rev. **14**: 7–28.

TABLE 1

*Comparative yield in kilograms of clean palay of the three varieties*

| PLOTS | VARIETIES | | | TOTAL | MEAN |
|---|---|---|---|---|---|
| | S.K. 36 | Inintiw | Apostol | | |
| 1 | 57.8 | 1.6 | 8.6 | 68.0 | 22.6 |
| 2 | 60.4 | 1.9 | 15.2 | 77.5 | 25.8 |
| 3 | 33.2 | 2.1 | 6.4 | 41.7 | 13.9 |
| 4 | 65.2 | 2.2 | 27.0 | 94.4 | 31.4 |
| 5 | 56.8 | 1.7 | 28.1 | 86.6 | 28.8 |
| Total..... 273.4 | | 9.5 | 85.3 | 368.2 | 24.5 |
| Mean..... 54.68 | | 1.9 | 17.06 | | |

*Analysis of variance*

| SOURCES OF VARIATION | DF | SUM OF SQUARES | VARIANCE | COMPUTED F-VALUE | TABULAR F-VALUE | |
|---|---|---|---|---|---|---|
| | | | | | 5% | 1% |
| Total..... | 14 | 8277.81 | | | | |
| Variety..... | 2 | 7251.34 | 3625.17 | 8.24 | 4.46 | 8.65 |
| Plot..... | 4 | 421.24 | 105.31 | 34.04 | 3.84 | 7.01 |
| Error..... | 8 | 603.23 | 75.40 | | | |

L.S.M.D. = 12.45

# THE FERTILITY OF MUSCOVY DUCK EGGS[1]

LAMBERTO J. TOLENTINO

In a study of the fertility of Mallard ducks, Fronda, Zialcita, and Dalisay (1940)[2] observed that when the proportion of drakes to ducks is 1 : 45, 2 : 50, or 3 : 60, a profitable fertility of eggs may be obtained two weeks after the introduction of the drakes in the pens. When the ratio is 4 : 50 or 5 : 50, however, eggs for hatching may be collected profitably after the first week. They also reported that eggs may be considered fertile to a profitable degree up to the fourth day after the withdrawal of the drakes from the pens. Eggs collected 12 days after the removal of the drakes, however, were no longer fertile.

The eggs of Muscovy ducks are generally incubated by natural methods. For this reason, a high percentage of infertility of the eggs causes loss of valuable space in the nest. This loss may be reduced to the minimum with some knowledge of the fertility of the eggs set. It is, therefore, of interest to know how long, after the introduction of a drake into a pen of layers, a profitable percentage of fertility may be obtained. A knowledge of the length of time needed in order that a profitable percentage of fertility may be maintained after the removal of the drake from the pen is likewise of interest.

## MATERIALS AND METHODS

This study was conducted from December, 1945, to October, 1946, in the Department of Animal Husbandry. Ten Muscovy ducks and one drake were used. The birds were placed in a laying house 2.5 meters by 2.0 meters, with two grassy lots adjoining it. They were given a ration that consisted of 50 parts rice bran, 20 parts palay, 15 parts ground corn, and 15 parts shrimp meal, all parts by weight. Chopped green grass was given to the birds morning and afternoon. The feed was given in sloppy form three times a day: once, about 6:30 o'clock in the morning; and twice in the afternoon, at 1:00 o'clock and 5:00 o'clock, respectively. At each feeding time, as much feed as could be consumed in about 15 minutes was given.

---

[1]Experiment Station contribution No. 1947. Thesis presented for graduation, 1947, with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 1503. Prepared in the Department of Animal Husbandry under the direction of Professor F. M. Fronda.

[2]FRONDA, F. M., L. P. ZIALCITA, AND A. DALISAY. 1940. The fertility of the duck egg. Philippine Agriculturist 29: 111–123.

Clean drinking water was made available to the birds throughout the day. The feedings at 6:30 in the morning and at 1:00 o'clock in the afternoon were done in the yards, and that at 5:00 o'clock in the afternoon was done inside the pen before the birds were confined in their quarters for the night.

The ducks were left in the pen alone until all of them had started to lay. After it had been ascertained that all eggs laid were infertile, the drake was introduced into the pen before daylight the next morning. The first series of observations were made on June 13; the second, on July 27; and the third, on September 1. All eggs laid during these periods were artificially incubated to determine their fertility.

When the maximum fertility of the eggs was reached and maintained for at least seven days, the drake was withdrawn from the flock. To determine the length of time that elapses before the eggs laid cease to be fertile, all eggs laid after the removal of the drake were incubated. All infertile eggs as determined by candling were opened for verification.

Observations on the mating habit of Muscovy ducks were also made. The observations were made daily for the first three days each time the drake was introduced into the pen. In making the observation, care was taken not to attract the attention of the ducks. The observation on the frequency of mating was made throughout the day, from 5:00 o'clock in the morning to 6:00 o'clock in the evening.

## DISCUSSION OF RESULTS

### *Fertility of eggs laid after the introduction of the drake in the pen*

In all the three series of observations made during the first 24 hours after the drake was introduced into the pen, no fertile egg was produced. On the second day of mating, however, fertile eggs began to appear in all the three series. On this day, in the first series, 50.0 per cent of the eggs laid were fertile; in the second, 40.0 per cent; and in the third, 50.0 per cent. The average percentage fertility in the three series of observations was 46.6.

On the third day of the first series of observations, a 50.0 per cent fertility was also observed. However, there was a sudden increase in fertility in the second and third series; the fertility for both was 100.0 per cent. On the third day, the average fertility in the three series was 83.3 per cent.

From the third day to the twelfth, a high percentage of average fertility was more or less maintained in the three series. During this period, the average fertility ranged from 79.0 to 91.6 per cent. On the thirteenth day, the average fertility in the three series was 100.0 per cent, which was maintained up to the seventeenth day, when the drake was removed from the pen.

It may be mentioned in this connection that, in the first series of observations, the percentage of fertility of the eggs gradually rose from the third day and reached the peak of 100.0 per cent on the thirteenth day. From the thirteenth day to the seventeenth, the fertility remained 100.0 per cent. In the second series, the 100.0 per cent level of fertility was maintained from the eleventh day, but in the third series, it was reached on the third day and remained so until the removal of the drake two weeks later.

*Fertility of the eggs laid after removal of the drake*

Based on the average percentage of fertility in the three series of observations, a still profitable percentage of fertility was obtained six days after the removal of the drake. Beginning on the seventh day, however, there was a gradual reduction of the average percentage of fertility until the last fertile eggs were produced on the thirteenth day.

As far as the decline of the percentage of fertility was concerned, individual observations gave slightly different results. For example, in the first series of observations, the maximum percentage of fertility was obtained on the first five days following the removal of the drake from the pen. After the fifth day, there was a gradual decline in percentage of fertility. The last fertile eggs were laid on the thirteenth day. In the second series of observations, a 100.0 per cent fertility of eggs was produced only for two days. There was an irregular decline in fertility from the third day, and the last fertile eggs were produced on the twelfth day. In the third series of observations, all eggs laid for five days were fertile. On the sixth day, the percentage of fertility dropped to 75.0 per cent, which gradually decreased daily up to the eleventh day, when the last fertile eggs were produced.

*Frequency of matings of the drake during the day*

It was observed that on the first day there were four matings in the first series of observations, five in the second, and six in the third. During the second day, there were three matings in the first series, seven in the second, and six in the third. During the third day, there were six matings in the first series, five in the second, and three in the third. These figures tend to show that the number of matings that a drake may be able to accomplish in one day varies from three to seven. The total number of matings during the nine days of observations was 45, or an average of $5.0 \mp 0.89$ a day. If the total number of matings on the first day is compared with that on the second and third days, the data show very slight difference; there were 15 matings on the first, 16 on the second, and 14 on the third. These results also show that apparently, the number of ducks that may be profitably allowed each drake is five.

It was also observed that mating was most frequent in the morning, from 5:00 o'clock to 12:00 o'clock noon, and towards late afternoon. In all cases, in the three series of observations, there were more matings in the morning than in the afternoon. In the first-day observations, in all trials, for example, of the 15 matings made, 12, or 80.0 per cent, were in the morning, and the rest in the afternoon. In the second-day observations, 9 of the total 16 matings, or 56.3 per cent, were in the morning, and in the third-day observations, 8, or 57.1 per cent, of the 14 matings were in the morning. Of the total of 45 matings observed in this experiment, 29, or 64.4 per cent, were in the morning.

It may be of interest to Muscovy duck raisers that out of the ten ducks in the flock, only two became broody after laying a clutch of eggs. This was observed during the first and third series of observations. One duck became broody in each series. The broodiness, however, was broken in the usual manner, and it took only three days to do it.

## SUMMARY

1. During the first 24 hours after the introduction of a Muscovy drake in a flock of layers, no fertile eggs were laid.

2. In all the three series of observations, fertile eggs were laid two days after the introduction of the drake into the pen.

3. A profitable percentage of fertility of the eggs laid was obtained on the third day after the drake was placed in the pen.

4. The eggs laid remained profitably fertile six days after the drake was removed from the flock. The last fertile eggs were laid on the thirteenth day.

5. The drake maintained the same number of matings during each of the three days of observation. The average number of matings on each of the nine days of observation was $5.0 \mp 0.89$.

6. The drake was observed to mate most actively in the morning.

# EFFECTS UPON THE YIELD OF RAMAI RICE OF AMMONIUM SULFATE, AMMO-PHOS, AND A HOME-MIXED FERTILIZER[1]

VALERIANO C. CALMA AND SATURNINO G. RICO
*Of the Department of Agronomy*

Ammonium sulfate and ammo-phos have been shown to increase the yield of Ramai rice; the best rate of application of each was 100 kgm. a hectare. Likewise, a combination of 200 kgm. of superphosphate and 40 kgm. of sulfate of potash a hectare was found to be the best rate of application of a home-mixed fertilizer. A study of the effect upon the yield of Ramai rice of these two fertilizers and a home-mixed fertilizer when applied at the same rate was conducted from June, 1941, to March, 1942, in the Experiment Station fields of the College of Agriculture, Los Baños, Laguna.

*Review of literature*

Aragon[2] reported that the application of 100 kgm. a hectare of ammo-phos (20 - 20 - 0) gave the highest net gain of ₱23.36 a hectare.

Asuncion[3] reported that a home-mixed fertilizer consisting of 200 kgm. superphosphate and 40 kgm. sulfate of potash to a hectare increased by 9.78 cavans the yield of Ramai rice over that of the control, which gave a computed net gain of ₱1.88 a hectare.

Butac[4] found that the application of 100 kgm. a hectare of ammonium sulfate gave the highest computed yield of 89.45 cavans, an increase over that of the control of 18.58 cavans a hectare. This gave a net gain of ₱28.66 a hectare.

Camus (1921) reported that an average crop of 40 cavans or 1,760 kgm. of palay a hectare will remove from the soil 20.64 kgm. of nitrogen, 10.32 kgm. of phosphoric acid, and 4.54 kgm. of sulfate of potash.

---

[1]Experiment Station contribution No. 1480. Prepared from the thesis presented by the junior author for graduation, 1945, with the degree of Bachelor of Science in Agriculture from the College of Agriculture.

[2]ARAGON, V. B. 1934. Increase your rice yield. Stockman and Farmer 1: 11–22.

[3]ASUNCION, A. F. The effects upon the yield of Ramai rice of fertilizers containing phosphorous and potash added to the soil in different proportions. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, 1934. Unpublished).

[4]BUTAC, F. L. 1934. The effects of ammonium sulfate upon the yield of Ramai rice. College of Agriculture Biweekly Bulletin 2 (17): 1–2. (Mimeographed).

Trelease and Jurado (1920) studied the effect of the addition of three salt solutions of primary calcium phosphate, ammonium sulfate, and sulfate of potash on the growth of rice in a water-saturated soil. They found that the yield of straw and grain was positively correlated with ammonium sulfate concentration in the solutions. The concentration of primary calcium phosphate and sulfate of potash had no relation to yield of grain and straw. They corroborate the results of Kelly (1914), in Hawaii, who used superphosphate, sulfate of potash, and ammonium sulfate, singly and in combination, in a series of experiments in lowland rice fields for seven consecutive crops and concluded that potassium and phosphoric acid were without effect. The application of ammonium sulfate at the rate of 168.4 kgm. a a hectare, however, produced a noticeable increase in yield, and the application of 336.8 kgm. of this salt to a hectare was more profitable than any other amount.

## MATERIALS AND METHODS

### *Seed and seedbed*

Selected Ramai rice was used in this experiment. A piece of land about 1,000 square meters was used for the seedbed, which was prepared in the usual wet-bed method.

### *Fertilizers*

Ammonium sulfate (20.6 - 0 - 0), ammo-phos (20 - 20 - 0), and a home-mixed fertilizer consisting of superphosphate (0 - 18 to 20 - 0) and sulfate of potash (0 - 0 - 48 to 50) were used.

The gunny sack containing the Ramai seeds was soaked in running water for 24 hours, placed in a shady place for another 24 hours to sprout the seeds, and on July 8, 1941, the germinated seeds were broadcast by hand uniformly on the seedbed at the rate of 23 gantas per 500 square meters. The dikes which at first were closed to prevent the water from carrying the seeds away were opened and closed at intervals to regulate the water supply until the seedlings were ready for transplanting.

### *The field*

The soil of the field used is clay loam and according to Galvez (1936) the soil of the lowland rice field of the College of Agriculture Experiment Station contains 0.16 per cent nitrogen, 0.20 per cent phosphoric acid, 0.10 per cent potassium, and 1.40 per cent calcium.

The field has been grown to rice every year for a number of years, and after the harvest, the land was left to fallow until the next season. The field was prepared in the usual way of preparing paddies. Twenty plots each 25 meters long and 20 meters wide, or 500 square meters, were used. Each treatment was replicated five times. On August 4, 1941, the seedlings

were pulled out, tied into bundles of five centimeters in diameter, and their tops pruned.

The following morning the 30-day-old seedlings were transplanted at the rate of two to three seedlings in each of the hills 25 centimeters apart.

*Application of fertilizers*

On August 20, 1941, two weeks after the transplanting of the seedlings, the fertilizers were broadcast by hand as uniformly as possible in all plots. One day before the fertilizers were applied, the dikes were opened to drain the water to a depth of two centimeters in all the paddies. After the application of the fertilizers the dikes were closed to prevent the water from going to the other paddies.

The water for the plants came mostly from the rain and the rest from irrigation ditches of the College. At the beginning there was an abundance of water because of the heavy rains. The dikes were opened to drain off the water in the dikes to a depth of about two centimeters. In the later part of August, 1941, the plots became dry owing to lack of rain. The dikes were opened after the blooming period.

As not much weeding was done the weeds grew vigorously, especially after the application of the fertilizers. However, no serious pests and diseases were observed either in the seedbed or in the field.

*Harvesting the crop*

The crop was harvested on January 10, 1942, threshed by treading on the panicles on buri mats spread on the plots from which they were harvested, the grains winnowed in shallow baskets, and the clean grains placed in sacks and weighed on a Fairbanks balance. From the weights of the harvest from the different plots the average yield per hectare was computed.

## Experiment and Results

*Observation of plants*

Emergence of the seedlings began three days after the seeds were broadcast in the seedbed. Except in places without water the seedlings were uniform in height, growth, and vigor, and free from pests and diseases.

The seedlings showed the effect of transplanting. Their leaves were pale green. Two weeks after the ammonium sulfate and ammo-phos fertilizers were applied, however, the plants showed considerable growth. They produced green, broad, and long leaves, whereas the plants treated with the home-mixed fertilizer and those of the control plots had uneven growths. Among the treated plots, those with the ammo-phos treatment had the best stand.

On November 28, 1941, all the fertilized plants showed lodging.

By taking at random twenty hills in each plot or 100 hills in each treatment the tillering and the number of bearing and nonbearing culms to the hill were determined.

The plants in the fertilized plots flowered in 136 days and matured in 182 days from being broadcast in the seedbed. The plants in the control plots flowered in 140 days and were harvested in 182 days.

The yield in kilograms of clean palay from each plot was computed on the hectare basis and converted into cavans by dividing the computed yield by 44.

Although there were no serious pests and diseases the seedlings suffered much after transplanting because there was not enough rain or irrigation water. Owing to the short dry spell, many of the plants in some portions of the treated plots and some of those in the control dried up. The plants did not receive water until it rained heavily on August 31, 1941, since when the weather improved. There were occasional rains to supply water continuously until the harvest

### DISCUSSION OF RESULTS

The mean yield of each plot varied from 62.92 kgm. with the home-mixed fertilizer to 95.84 kgm. with the ammo-phos. Although there were slight differences in yield between the treated plots and the control, the results were not significant. The writers' results do not agree with those of Asuncion[5] who worked with a home-mixed fertilizer, Aragon[6] with ammo-phos, and Butac[7] with ammonium sulfate. These investigators reported significant results. The insignificant results obtained by the present writers may be attributed partly to the supply of water during the early growth of the plants insufficient for their requirements and for keeping down the weeds. Undoubtedly, the abundance of weeds in the fertilized plots affected the rice plants adversely.

The profit or loss due to the different treatments was determined by taking into consideration these different items: (*a*) the cost of the fertilizers in Manila and of the transportation to College, (*b*) the cost of application of the fertilizers in the field, and (*c*) the price of palay at the time the crop was harvested. The difference between the computed yield in cavans per hectare of each treatment and the control multiplied by the price of palay, which was ₱3.30 at the time of the harvest in February, 1942, gave the value of the increase in yield per hectare. From the value of the increase in yield, the costs of fertilizer, transportation, and application were sub-

[5] ASUNCION, *op. cit.*
[6] ARAGON, *op. cit.*
[7] BUTAC, *op. cit.*

tracted, and the difference was the profit per hectare. To the value of the decrease in yield, the costs of fertilizer, transportation, and application were added, and the sum was the loss per hectare. The highest expense was incurred in the use of the home-mixed fertilizer, which was ₱43.70, and the lowest, in that of ammonium sulfate, ₱14.65 per hectare. All of the treatments, except that with the home-mixed fertilizer, gave a slight increase in yield over the control plot (table 1). The plots treated with ammonium sulfate gave 0.3 cavan and those treated with ammo-phos gave 3.2 cavans more per hectare than the control; whereas the plots treated with the home-mixed fertilizer gave 11.8 cavans per hectare less than the control. All of the treatments incurred losses. The highest loss of ₱82.64 was obtained from plants treated with the home-mixed fertilizer, and the lowest loss of ₱6.09 was incurred in the ammo-phos treatment. These results should serve as a warning to advocates of fertilizers as a means of increasing the yield of lowland rice. Fertilizers should be used only when sufficient irrigation water is available during the growing season of the lowland rice crop.

## SUMMARY

1. Two weeks after the application of ammonium sulfate and ammo-phos fertilizers, the plants produced a better stand and were darker green and more vigorous than those in the control and in the plots treated with the home-mixed fertilizer.

2. The plants in the fertilized plots lodged slightly.

3. The application of the different fertilizers did not affect the number of bearing culms of the plants.

4. The different fertilizers hastened the flowering period of the rice plants but did not affect the maturity period.

5. None of the fertilizers applied had any significant effect upon the yield, probably because of the shortage of water during the early stage of development of the rice plants. Irrigation water was not sufficient to submerge the weeds and kill them. There was an abundance of weeds, which grew more luxuriantly in the fertilized plots than in the control.

6. The results seem to indicate that one should be wary about applying fertilizers to lowland rice unless sufficient irrigation water is available during the growing season. Computed on actual costs, the fertilized plots gave the following losses: ₱82.64 for the home-mixed fertilizer consisting of 200 kgm. of superphosphate and 40 kgm. sulfate of potash; ₱13.66 for 100 kgm. of ammonium sulfate; and ₱6.09 for 100 kgm. of ammo-phos per hectare.

## LITERATURE CITED

Camus, J. S. 1921. Rice in the Philippines. Philippine Agric. Rev. **14**: 7–86.

Galvez, N. L. 1936. Plant food reserves in lowland and upland soils. Philippine Agriculturist **25**: 221–232.

Kelly, W. P. 1914. Rice soil of Hawaii. Hawaii Agric. Exper. Sta. Bull. **31**: 1–23.

Trelease, S. F., and M. Jurado. 1920. The growth of rice as related to concentration of fertilizer salts added to soil culture. Philippine Agriculturist **8**: 67–87.

TABLE 1

*Profit or loss due to application of different kinds of fertilizers* [a]

| TREATMENT | YIELD | | INCREASE OR DECREASE IN YIELD PER HECTARE [b] | VALUE OF INCREAZE OR DECREAZE IN YIELD PER HECTARE DUE TO THE APPLICATION OF FERTILIZER | COST OF FERTILIZER AND ITS APPLICATION | LOSS DUE TO APPLICATION OF FERTILIZER |
|---|---|---|---|---|---|---|
| | ACTUAL | COMPUTED | | | | |
| | For each 500 sq. m | For each hectare | | | | |
| | *kilograms* | *cavans* | *cavans* | *cavans* | *pesos* | *pesos* |
| Ammonium sulfate | 89.52 | 40.7 | 0.3 | 0.99 | 14.65 | 13.66 |
| Ammo-phos | 95.84 | 43.6 | 3.2 | 10.56 | 16.65 | 6.09 |
| Home-mixed | 62.92 | 28.6 | —11.8 | —38.94 | 43.70 | 82.64 |
| Control | 88.88 | 40.4 | | | | |

[a] The current price of Ramai per cavan of 44 kgm. was ₱3.30.

[b] The control was used as basis for the computation of the increase or decrease in yield.

# DISTILLERY YEAST, A POSSIBLE FEED FOR POULTRY[1]

F. M. Fronda and Melchor E. Fronda
*Of the Department of Animal Husbandry*

There has been lately a shortage of shrimp meal and fish meal which are generally used by poultry raisers in the Philippines as protein supplement in poultry rations, and our farmers are confronted with the big problem of supplying their flocks with rations that are properly supplemented with a protein feed. In order to find a possible substitute for these essential components of poultry rations, distillery yeast, a waste product in the liquor industry, was tried as a supplement in both growing and laying rations.[2] So far, no other work along this line has been done in this country or elsewhere. Heuser (1946)[3] listed two distillers' dried yeast products. One of these is the "grain distillers' dried yeast," which he defined as "the properly dried yeast resulting from the fermentation of grains and yeast, separated from the mash, either before or after distillation." The other product, "molasses distillers' dried yeast," is a product of the fermentation of molasses and yeast, and separated from the medium, either before or after distillation. According to Heuser, yeast is a rich source of the vitamin B complex and can be used in poultry rations for this purpose.

The product used in this study was probably similar to "grain distillers' dried yeast." It was obtained from La Tondeña Distillery in Manila in a form similar to moist black mud and with a very strong alcoholic odor. For this reason, it had to be thoroughly air-dried and ground before it was incorporated in the ration. Incidentally, the alcoholic odor of the yeast was considerably reduced after drying.

Three trials were made. The first trial was made on three-week-old Nagoya chicks; the second, on Los Baños Cantonese weanlings; and the third, on Los Baños Cantonese layers. The first two trials covered a period

---

[1]Experiment Sation contribution No. 1481. The data used in this paper were taken from the thesis presented in 1946 by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, University of the Philippines.

[2]Distillery yeast is discarded as waste product in the distilleries, and its proper disposal has at times become a problem. For this reason, it can be obtained easily in fairly large quantities.

[3]Heuser, Gustave F. 1946. Feeding poultry. vii+543p., 10 fig. New York: John Wiley & Sons, Inc.

of twelve weeks each. The trial on laying hens had to be discontinued after the nineteenth week owing to war conditions.

The ration given to the three-week-old chicks and to the weanlings consisted of the following ingredients, all parts by weight:

| INGREDIENTS | LOT I | LOT II |
|---|---|---|
| Rice bran | 60 | 60 |
| Corn meal | 20 | 20 |
| Fish or meat scraps | — | 15 |
| Distillery yeast | 15 | — |
| Copra meal | 5 | 5 |
| Total | 100 | 100 |

The ration given to the layers consisted of the following ingredients, all parts also by weight:

| INGREDIENTS | LOT I | LOT II |
|---|---|---|
| Rice bran | 40 | 40 |
| Copra meal | 30 | 30 |
| Corn meal | 20 | 20 |
| Fish or meat scraps | — | 10 |
| Distillery yeast | 10 | — |
| Total | 100 | 100 |

In all the trials, feed was given mostly in the form of dry mash. Fresh drinking water was made available to the birds throughout the day. The birds were allowed to roam freely in the runs adjoining the pens. At times, chopped mixed grasses had to be given to supplement the available grass already present in the runs.

## DISCUSSION OF RESULTS

### *Experiments with growing chicks*

The weekly gain in weight of the chicks was used as the basis of determining the influence of distillery yeast on growth. In the first trial, the birds that received the ration containing distillery yeast had a mean weekly gain in weight of 23.6 grams, and those that did not, 34.1 grams. Apparently, the chicks that did not receive distillery yeast were heavier than those that received it. The difference, however, when statistically analyzed was found to be insignificant. In the second trial, the chicks that received distillery yeast (lot I), had an average weekly gain of 42.6 grams, and those that did not (lot II), 40.4 grams.

The comparison of feed consumption was made by using the average feed consumption per chick in both lots. It was observed that there was not much difference in the amount of feed consumed in each lot for

both the first and second trials. The results show that the use of distillery yeast in the ration did not cause any unfavorable effect on the palatability of the ration.

The mortality of the chicks in the first and second trials was not influenced by the addition of distillery yeast to the ration. In the first trial, not a single chick died in the lot that received distillery yeast, but there was a mortality of 16.6 per cent in the normal or check lot. In the second trial, not a single mortality occurred in both lots. These results show that apparently distillery yeast did not influence mortality among the birds.

*Experiment with laying hens*

The average weight of the hens after nineteen weeks showed that feeding the hens with either fish scraps or meat scraps or distillery yeast in the ration produced practically the same results. The hens in both cases showed a tendency to increase in weight. The hens that were given distillery yeast in their ration had an average initial weight of 1003.6 grams and an average final weight of 1286.5 grams. The percentage increase in weight was 21.2. On the other hand, the hens that did not receive this supplement had an average initial weight of 1018.2 grams and an average final weight of 1431.2 grams. The percentage increase was 28.8. It may be noted, however, that the hens which were fed the regular laying ration containing either fish scraps or meat scraps (lot II), attained a slightly higher percentage increase in weight than the hens in the experimental lot (lot I), although this difference was not significant.

It was also observed that the hens that received the ration containing distillery yeast had an average feed consumption per bird of 17.3 kilograms for nineteen weeks, while those that did not consumed an average of 18.1 kilograms during the same period. This apparently large amount of feed consumed by the hens in both lots may be attributed to the fact that the hens were in confinement most of the time and were, therefore, always near the feed troughs.

In spite of the rather close confinement of the birds, not a single hen died in both lots. The result obtained corroborates the results obtained in the first and second trials. Apparently the use of distillery yeast in the feed does not decrease the vitality of the birds.

Observations on the effects of distillery yeast on egg production showed that the inclusion of this product did not influence egg production adversely. The total number of eggs produced by the hens that received distillery yeast in their ration was 60, thus giving a percentage production of 45.0 The hens that received the normal ration produced a total of 68 eggs, or a percentage production of 50.4. This difference between the two

lots, however, was found to be statistically insignificant. These results indicate that the distillery yeast apparently exerted almost the same influence on egg production as did the meat scraps or fish scraps.

## SUMMARY AND CONCLUSION

1. The gain in weight made by the chicks that received distillery yeast in their ration was essentially the same as that made by the chicks in the check lot.

2. The use of distillery yeast in the ration did not adversely influence the amount of feed consumed by both growing stock and layers.

3. Apparently, the use of distillery yeast in the ration did not decrease the vitality of both growing stock and layers.

4. The rate of egg production in the experimental lot was slightly lower than that in the control lot, but the difference was not statistically significant.

5. Judging from the results obtained in these trials, it may be concluded that distillery yeast may be profitably used in poultry rations, either for growing chicks or for layers.

# YIELDS OF BROADCAST AND TRANSPLANTED SERAUP KECHIL 36 RICE[1]

GUILLERMO T. PALIS AND VALERIANO C. CALMA
*Of the Department of Agronomy*

The work to determine the yields of rice planted by broadcast and by transplant was conducted from August, 1944, to February, 1945, in the field of the Experiment Station of the College of Agriculture, Los Baños, Laguna.

Aragon and Cada (1939) reported that of the varieties of rice introduced from the Federated Malay States, Seraup Kechil 36 and Seraup Kechil 146 were the highest yielders and the most promising for the Philippines. These writers found that Seraup Kechil 36 matured, on the average of two plantings, six months after sowing.

Calma and Cada (1941) also found that Seraup Kechil 36 was one of the highest yielders. It matured 182 days after sowing and gave an average yield of 64.5 cavans a hectare.

Villegas[2] found that Seraup Kechil 36 gave a computed mean yield of $73.69 \mp 3.16$ cavans a hectare and outyielded both Macan Señora and Lamio.

Capili (1934), in a comparison of broadcast and transplanted Ramai, reported $20.03 \mp 3.33$ cavans more to the hectare when the rice is transplanted than when it is broadcast. The yield per hectare when transplanted was $66.71 \mp 3.32$ cavans and when broadcast, $46.68 \mp 0.26$ cavans. He reported further that broadcast Ramai matured 156 days after planting and the transplanted, 162 days after sowing in the seedbed.

## EXPERIMENT, RESULTS, AND DISCUSSION

The Seraup Kechil 36 rice used in this experiment was obtained from the Division of Annual Farm Crops, Department of Agronomy, College of Agriculture.

The land selected was 2,400 square meters in size, of clay loam soil, and located in one of the lowest portions of the lowland rice fields of the

[1]Experiment Station contribution No. 1482. Based on a thesis presented November, 1945, by the senior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture.

[2]VILLEGAS, J. J. A comparative study of Seraup Kechil 36, Macan Señora, and Lamio. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1944. Unpublished).

Experiment Station. It is planted to rice except in February to July when it is fallowed.

Four plots of approximately 300 square meters each were prepared for each method of planting. The plots were randomized to allow analysis of variance.

*Broadcast culture*

The land was prepared in the usual way of preparing lowland rice fields.

On October 1, the seeds in a gunny sack were soaked in running water for 24 hours and then allowed to sprout in the shade for another 24 hours. On October 4, the sprouting seeds were broadcast in the seedbed. As only 50 per cent of the seeds germinated, seeding was made at the rate of two gantas to a paddy of 300 square meters. The seedlings emerged in five to seven days. A week later, sufficient water was turned into the paddies to kill the weeds and accelerate the growth of the seedlings. The stand was not uniform although the seedlings were vigorous. Weeding was done when the weeds began to overcrowd the young rice.

*Transplanted culture*

The ordinary wet-bed seedbed was prepared. The seeds were prepared in exactly the same manner as in the broadcast culture except that the sprouting seeds were sown in the seedbed on August 30 at the rate of 20 gantas to every 500 square meters.

The paddies for transplanting the seedlings were also prepared in the same way as those for the broadcast culture.

On October 4, when the seedlings were 35 days old, they were pulled by hand and tied into bundles of about four to five centimeters in diameter each. The seedlings were pruned to one-third their height to reduce transpiration. In hills 25 centimeters apart seedlings were transplanted at the rate of two to three to a hill.

After transplanting, the inlet dikes were closed for about ten days to give the seedlings time to establish themselves in the soil. After about a week, water was turned into the paddies to hasten the growth of the plants.

*Broadcast and transplanted cultures compared*

Weeding was done as the rice plants grew and weeds began to overrun them. Only the rice weaver (*Lonchura ferruginosa jagori*), which fed on the grains of the panicles of the maturing plants, attacked the crop. As with the broadcast culture the damage from the birds was minimized by driving them away as they came to feed. The transplanted seedlings recovered from the effects of transplanting after about two weeks and established them-

selves in the soil although they were still pale green. After about a month, marked differences were noted in growth and height. The transplanted rice developed faster and were more uniform in height than the broadcast, although there was no marked difference in color of plants. As the plants approached maturity, there was a marked difference in height. The plants from seeds broadcast directly in the paddies were somewhat stunted in growth, owing perhaps to overcrowding in some parts of the paddies.

Lodging took place when the rice plants approached maturity. The plants in the transplanted culture lodged earlier than those in the broadcast culture. Evidently, the transplanted rice produced heavier panicles than the broadcast.

As to dates of flowering, the broadcast rice bloomed in 113 to 115 days, whereas the transplanted bloomed in 126 to 127 days. The transplanted rice matured in 160 days from sowing in the seedbed and those from broadcast seeds matured in 147 days from broadcasting in the field.

The plants from the broadcast rice had a mean height of 132.1 centimeters whereas the transplanted ones had a mean height of 138.1 centimeters, or a difference of 6 centimeters. This difference in height of the plants is statistically significant. It is evident that the transplanted seedlings had sufficient space for normal development whereas those from broadcast seeds were crowded and therefore stunted in growth.

As the grains approached maturity the plants lodged. Lodging, however, was more frequent in the transplanted rice, probably owing to the fact that the grains of the panicles of the transplanted rice were heavier.

The broadcast rice flowered in 113 to 115 days after broadcasting and matured in 147 days. The transplanted rice flowered in 126 to 127 days after sowing in the seedbed and matured in 160 days. The transplanted rice flowered and matured later than the broadcast rice probably because the growth of the plants was retarded as a result of the pulling and pruning of the seedlings. As the growth of the broadcast rice was not disturbed, the plants flowered and matured early. The broadcast crop was harvested with a "lilik" or "pangapas" on February 28, 1945, 147 days after broadcasting. The transplanted rice was harvested with the same tool on February 6, 1945, 160 days after sowing in the seedbed, or 125 days after transplanting in the paddies. The harvest from each plot was threshed immediately, winnowed, placed in sacks, and measured.

The mean percentage of developed grains was 82 in the transplanted rice, and 80.3 in the broadcast. The difference of 1.7 per cent was insignificant. Table 1 shows that there was a significant difference in the mean yield of palay. The transplanted rice gave a mean yield of 93.9 kilograms to every 300 square meters and the broadcast, 62.6 kilograms. The differ-

ence of 31.3 kilograms was significant. Based on 44 kilograms a cavan, the transplanted rice crop gave a computed yield of 71.14 cavans a hectare and the broadcast 47.46 cavans. The result showed a difference of 23.68 cavans a hectare in favor of the transplanted rice.

The results of the present study corroborate those of Capili (1934), who found that the yield of Ramai rice per hectare was $66.71 \mp 3.32$ cavans when transplanted and $46.68 \mp 0.26$ cavans when broadcast, showing a difference of $20.03 \mp 3.33$ cavans.

The low yield from the broadcast rice may be attributed partly to the uneven stand of the plants in the paddies. It may also be due to the fact that the paddies of the broadcast rice were more weedy than those of the transplanted. The weeds in the former started to grow almost at the same time as the rice seedlings. It was difficult to kill the weeds by submerging them in irrigation water without adversely affecting the young rice plants. In the paddies of the transplanted rice, the plants were already about 30 centimeters tall when the weeds began to grow, so that most of the weeds could be killed by submerging them in water. Cabailo (1925) noted that the yield of rice is adversely affected by weeds. Weeded fields gave higher yields than those not weeded.

## SUMMARY

1. The transplanted rice plants were significantly taller than the broadcast plants, their respective mean heights being 138.1 and 132.1 centimeters.

2. The transplanted rice flowered in 126 to 127 days after sowing in the seedbed and matured in 160 days. The broadcast rice flowered in 113 to 115 days after being broadcast in the field and matured in 147 days.

3. The plants in both methods of planting lodged as they approached maturity. There was more lodging in the transplanted rice plants than in the broadcast.

4. The mean percentage of developed grains in the transplanted crop was 82, and 80.3 in the broadcast rice; the difference of 1.7 per cent was insignificant.

5. There was a marked difference in the mean yields of rice of the two methods of planting. The transplanted rice had a computed mean yield of 71.14 cavans a hectare; the broadcast rice crop, only 47.48 cavans. The low yield from the broadcast rice may be attributed partly to the uneven stand of the plants in the paddies and to weeds.

## LITERATURE CITED

Aragon, Vicente B., and Esteban Cada. 1939. A preliminary report on the performance of ten rice varieties from the Federated Malay States. Philippine Agriculturist **27**: 635–646.

Calma, Valeriano C., and Esteban Cada. 1941. Comparative test of six varieties of rice. Philippine Agriculturist **30**: 548–554.

Cabailo, Benjamin C. 1925. Weeds in the rice fields and their effect on the yields of grain. Philippine Agriculturist **14**: 359–371.

Capili, Justo P. 1934. Comparison of yields from Ramai variety of rice broadcast and transplanted. Philippine Agriculturist **23**: 286-294.

TABLE 1
*Comparative yield in kilograms*

| PLOTS | METHODS OF PLANTING | | DIFFERENCE (T-B) |
|---|---|---|---|
| | *Broadcast* [a] | *Transplanted* | |
| 1 | 60.0 | 68.4 | 8.4 |
| 2 | 57.8 | 99.8 | 42.0 |
| 3 | 78.5 | 108.0 | 29.5 |
| 4 | 54.3 | 99.6 | 45.3 |
| Total | 250.6 | 375.8 | 125.2 |
| Mean | 62.6 | 93.9 | 31.3 |

$$\bar{sd} = \sqrt{\frac{2V}{N}} = \sqrt{\frac{2\times208.9}{2}} = \sqrt{104.4} = 10.2$$

$$\bar{d} = 31.3;\ t = \frac{\bar{d}}{\bar{sd}} = \frac{31.3}{10.2} = 3.06;\ df = 6;\ t = \begin{matrix} 5\% & 1\% \\ 2.447 & 3.707 \end{matrix}$$

[a]The harvest from the broadcast rice was measured first by the ganta and then computed on the kilogram basis because the balance was not available at the time of the harvest.

# AN ADDITIONAL INSECT VECTOR OF BUNCHY-TOP OF ABACÁ, OR MANILA HEMP PLANT[1]

R. C. Espino[2] and G. O. Ocfemia

*Of the Department of Plant Pathology*

WITH ONE TEXT FIGURE

The senior author submitted a master's thesis in 1944 entitled "A Study of Biologically Transmitted Viruses with Special Reference to Those Causing Bunchy-top of Abacá and Fiji Disease of Sugar Cane." With the use of young abacá plants grown from seeds and by following experimental procedures described by the junior writer in an earlier paper[3] on bunchy-top of abacá, it was found that *Pentalonia caladii* van der Goot could transmit the disease from abacá to abacá. The aphids used in the experiments were determined by Dean L. B. Uichanco in his home town, Calamba, Laguna, after the Japanese military authorities had dismissed him from the College of Agriculture. Unfortunately all records of the experiments and all copies of the thesis, including the file copy for the library of the University of the Philippines in Manila, were burned during the battle for liberation of the Philippines in February, 1945.

The aphids used in the experiments were growing on varieties of *Caladium bicolor* (Ait.) Vent. (fig. 1). The writers noted that *Pentalonia caladii* does not seem to adapt readily to abacá and does not colonize as fast thereon as on *Caladium*. Under field conditions, *Pentalonia caladii* does not seem to be of importance as a vector of abacá bunchy-top because apparently abacá is not a normal host of this aphid. If *P. caladii* is forced to feed on abacá, however, it may gradually adapt itself to feeding on this host and transmit bunchy-top from abacá to abacá as does *Pentalonia nigronervosa* Coq. Species of aphids belonging to other genera cannot communicate the disease. The result furnishes an additional example of a disease caused by a virus biologically transmitted by two different, though closely related, insect vectors. The work on the disease and its additional vector is being continued.

---

[1]Experiment Station contribution No. 1482.

[2]Formerly assistant instructor in plant pathology (1943–1945).

[3]Ocfemia, G. O. 1930. Bunchy-top of abacá, or Manila hemp: I. A study of the cause of the disease and its method of transmission. Amer. Jour. Bot. 17: 1–18. *Pl. 1-4.*

Fig. 1.—Part of a single plant of *Caladium bicolor* (Ait.) Vent. showing heavy infestation of *Pentalonia caladii* van der Goot on the lower portion of the petioles. Slightly reduced. (*Photograph courtesy of Feliciano J. Garcia*)

## A REVIEW: POULTRY PRODUCTION[1]

For many years now, Lippincott and Card's *Poultry Production* has been a popular book with students of poultry and with others who are engaged in the raising of poultry for profit. They will be pleased to learn that the seventh edition (1946) of this book is now available. Several chapters have been completely rewritten and a new chapter on the control of diseases and parasites has been added.

The fifteen chapters of the book are each truly representative of the major phases of poultry production. The first chapter will give Philippine poultry raisers an idea of the present status of the poultry industry of the United States, a level that may well be used as a goal to which the local poultry industry may be developed. The second chapter covers the characteristics of the different breeds of chickens, and the principles underlying their selection and improvement. The next ten chapters discuss the fowl as a living organism, its reproduction, breeding for improvement, and feeding and management for the most profitable results.

Of special interest to Philippine poultry producers is Chapter XII, on management practices. In this chapter, some of the more important practices involved in successful poultry management are mentioned by way of calling attention to them and emphasizing their importance to anyone who wishes to make a living from poultry. These practices include feeding of both growing and laying stock; the use of artificial light; housing, including the use of battery laying cages; breeding and methods of mating; and other important practices that enter into the problem of poultry management.

Losses from diseases and from parasites have always been important problems to poultry raisers. Chapter XIII gives practical suggestions on the control of diseases and parasites. In this connection, however, the poultry raiser is reminded that the disease problem "may be looked upon as a constant struggle between the host and the invading organisms." For this reason "he must plan and carry out a program of flock management that will turn the tide of battle always, or nearly always, in favor of the host."

---

[1]Lippincott, William Adams, and Leslie E. Card. 1946. Poultry Production. Seventh edition, 440 p., fig. 1–236. Philadelphia: Lea & Febiger. General contribution No. 786.

Although the marketing of poultry and poultry products is not yet a problem to local poultry raisers, if poultry keeping is expanded beyond the needs of home consumption and is made a matter of producing chickens and eggs for profitable sale, some form of marketing becomes necessary. Chapter XIV can serve as a good guide in marketing poultry and poultry products and in the care and handling of eggs on the farm in order to enable the eggs to reach the market in good condition.

Those who are particularly interested in poultry keeping as a business will find Chapter XV very helpful. Poultry production as a business need not necessarily be confined to commercial poultry farms. Farmers may easily keep a flock of hens—a flock that if large enough, may provide an income sufficient to furnish a large part of the living for the farm family.

The extensive list of selected references included at the end of each chapter helps make the book useful to readers who may wish to examine other publications relating to the subjects discussed in the chapter. An attempt has been made in this edition to interpret the facts presented in each chapter in order to avoid mere compilation which may lead to confusion. This interpretation of facts and the omission of technical points that are still controversial in nature make the book really helpful to students and to others who seek an understanding of the science and practice of poultry husbandry.

F. M. Fronda
*Of the Department of Animal Husbandry*

## COLLEGE AND ALUMNI NOTES

*Loyalty Day*

The 1946 Loyalty Day was celebrated in the College on October 10. Two plays, one in Tagalog and the other in English, directed by Miss Aurora L. Samonte and Mr. Marcelo V. Arnaldo, respectively, were presented before a packed audience on the evening of October 9. The literary-musical program held on the morning of October 10 consisted of folk dances, a declamation in Tagalog, and vocal and instrumental numbers. President B. M. Gonzalez, the guest of honor, delivered an extemporaneous speech. He was introduced by Dean Uichanco, who also administered the Oath of Loyalty. The former Philippine Constabulary orchestra assisted in the program. The student body dance in the evening climaxed the celebration.

Among the alumni who took part in the Loyalty Day celebration were the following: B. M. Gonzalez, '13, Claro Samonte, '18, José Noguera, '19, Juan P. Torres, '19, Nemesio Catalan, '20, Rufino Isidro, '20, Pedro A. Rodrigo, '21, Juan O. Unite, '21, Basilio L. Hernandez, '22, Rafael M. Piguing, '22, Pablo N. Mabbun, '23, Francisco C. Pañganiban, '24, Pablo Quizon, '25, Quintin A. Eala, '27, Primitivo Tugade, '27, Felix F. Villa, '28, M. S. Celino, '29, Andres M. Mane, '29, Jacinto B. Leoncio, '30, José L. Morales, '31, Manuel A. Tuya, '31, Marcos Vega, '31, Pedro P. Erce, '32, Felipe T. Aala, '34, Nicomedes C. Reyes, '34, Alfonso L. Tecson, '34, Paulino Guerrero, '35, Antonio Gianzon, '38, José P. W. Tantoco, '39, B. S. Castillo, '40, Potenciano Reaño, '40, Jesús Bueno, '44, Zoraida P. Indemne, '45, Jorge J. Villegas, '45, M. E. Fronda, '46, and Norberto C. Palis, '46.

*Alumni activities*

Dr. Deogracias Villadolid, '19, was appointed director of the newly created Bureau of Fisheries. He was formerly an assistant professor of agricultural zoology in this college.

Mr. Felix D. Maramba, formerly assistant professor of agricultural engineering in this college and newly appointed Director of the Bureau of Plant Industry; Dr. Gonzalo F. Merino, '14, and Mr. Faustino Q. Otanes, '18, Chief and Assistant Chief, respectively, of the Plant Pest and Disease Control Division; and Mr. José L. Morales, '31, assistant agronomist, visited the College on July 30, 1946. They conferred with Dean Uichanco and other entomologists of the College on the problem of locust control.

Mr. Arcadio G. Matela, '29, supervisor of agricultural instruction in the vocational division of the Bureau of Education, is a pensionado in voca-

tional education in the United States. Mr. Hilario J. Santos, '36, supervisor of industrial arts is in the same division.

A number of Siamese who graduated from this college now occupy important positions in their country. Mr. L. M. Thuan Komkris, '34, is head of the Animal Husbandry Division of the Department of Animal Industry of Thailand. Mr. Prayoon Siddhichai, '41, is Chief of the Cattle Section, and Mr. Saluey Emasiri, '38, Chief of the Dairy Section. Mr. Charoon Subsaeng, '28, is Minister of Agriculture in the new cabinet; Kinluang Swan (Mr. Thongdee Resonondh), '24, is President of the University of Agriculture; and Mr. Roem Purnariksha, '28, is head of the Division of Agricultural Chemistry. Mr. Pra Chuang is Director of the Department of Agriculture, and Mr. Charas Sundarasingha, '28, registrar and professor of chemistry in the College of Agriculture.

Mr. Magdaleno Cero, '32, who has long been in the service of the government of Thailand, is at present in charge of the soil survey and of rice-fertilizer experiments in that country. He also teaches courses in soils at the College of Agriculture.

Mr. José C. Saddul, '32, is now acting superintendent of the Central Luzon Agricultural School, Muñoz, Nueva Ecija. Mr. Saddul is the youngest superintendent in the Bureau of Education.

The Honorable Domingo B. Paguirigan, '16, representative from Isabela, is the first alumnus of the College to be elected to the Philippine Congress.

Undersecretary José S. Camus, '14, and Mr. Francisco D. Marquez, '15, both of the Department of Agriculture and Commerce, attended the meeting of the Far Eastern Committee of the UNRRA in Nanking, China.

Mr. Pedro Montellano, '15, head of the agricultural education work in the Bureau of Education, on February 19-22, 1947, conferred with Dean Uichanco and the members of the staff of the Department of Agricultural Education on matters pertaining to vocational education in agriculture. Mr. Montellano spoke of the relation between the training of agricultural teachers in the College and the program of vocational education in agriculture in the Bureau of Education. He mentioned the lack of well-trained teachers of agriculture as one of the biggest problems of the Bureau. Mr. Montellano was formerly an instructor on special detail in the Department of Agricultural Education of the College.

Mr. Toh Jin Siong, '43, was in October, 1946, appointed lecturer in the department of horticulture of Fukien Christian University in Foochow, China. Mr. Toh found it difficult at the start because his lectures, which were in English, had to be translated into Chinese. Later, however, he overcame the difficulty. His students think very highly of the College of

Agriculture in Los Baños from which he graduated. He is the only member of the faculty who has been trained in a Philippine educational institution.

Hon. Dennis Molintas, '34, governor of the Mountain Province, and who immediately after graduation joined the teaching staff of the Trinidad Agricultural High School, was awarded the military medal of merit in connection with the July Fourth celebration held at Burnham Park in Baguio. He was a major in the 66th Infantry, P.A., a guerrilla unit, and was given the award in recognition of his meritorious service.

Mr. Victorino Borja, '34, rice specialist of the Bureau of Plant Industry, was a member of the Philippine delegation to the rice conference held in India.

Mr. Cornelio V. Crucillo, '25, a member of the Philippine Agricultural Mission to the United States, returned by plane on December 23, 1946. He is the chief of the technical division of the Department of Agriculture and Commerce.

*American agricutural mission to the Philippines*

Dr. Leland Everett Call, chairman of the American Agricultural Mission to the Philippines, was the guest speaker at the special convocation in the College on July 16, 1946. Doctor Call spoke on the factors that contributed to the tremendous food production in the United States during the last war. The guest speaker is the dean of the College of Agriculture and the director of the agricultural experiment station of Kansas State College.

The other members of the Mission who came with Doctor Call were Dr. Harry Clayton Sanders, director of the agricultural extension service, Louisiana State University; Dr. John Herbert Beaumont, director of the agricultural experiment station, University of Hawaii; Dr. Glenn Laird Taggart, social scientist, Office of Foreign Agricultural Relations, U. S. Department of Agriculture; and Dr. John B. Hepler of the Agricultural Extension Service, U. S. Department of Agriculture. The other visitors who came were Mr. and Mrs. C. A. Boonstra of the American Embassy in Manila.

After the convocation the College faculty gave the visitors a luncheon in the Agronomy Main Building.

With the mission came the following alumni and government officials: Mr. Francisco Galang, '14, chief of the agricultural extension division, Bureau of Plant Industry; Dr. Amando M. Dalisay, '37, of the Office of Foreign Relations; Mr. Dominador Rosell, '28, and Dr. Marcos Alicante of the Soil Conservation Service; and Dr. Pedro S. Sales of the Bureau of Animal Industry.

*Former members of the faculty*

Dr. Horace Grove Deming wrote Dean Uichanco inquiring about the fate of the College in World War II. Dr. Deming was with the College

from 1911 to 1916 as professor and head of the Department of Agricultural Chemistry. Two of his six children were born in the Philippines. He is at present on the faculty of the University of Nebraska. He is the author of books in chemistry which are used as standard texts in American colleges and universities. He offers to send books and equipment to the College. He plans to visit the Philippines.

According to advices, Mrs. Deming died in Lincoln, Nebraska, on September 23, 1946, after thirty-four days of illness.

Dr. Robert L. Pendleton, former head of the Department of Soils in this college and soil scientist in the Office of Foreign Agricultural Relations of the U.S. Department of Agriculture during the war, has been appointed professor of tropical agriculture and soils in the Department of Geography, Hopkins University.

Mrs. Harriett L. Richards, assistant professor of English in this college until the outbreak of the war, is now teaching in a girls' school in California. Until the liberation of Manila, she was interned in the Santo Tomas Internment Camp by the Japanese. She lost her two sons in the British Army on the European front.

Mrs. Ruth M. Mack, another former assistant professor of English in this college, returned to China from DePauw University, Indiana, on December 15, 1946, to resume her connection with the faculty of Lingnan University. Her husband, Dr. K. C. Mack, a graduate of the College of Veterinary Science, University of the Philippines, is a colonel in the Chinese Army.

Mrs. Guadalupe F. Ganzon, assistant professor in the Department of Agricultural Education, was transferred to the College of Liberal Arts in Manila on June 1, 1946. She was subsequently appointed fellow of the University of the Philippines for postgraduate work in history at Leland Stanford.

Mr. Merle A. Foster, former professor and head of the Department of Agricultural Education, visited the College on Tuesday, May 14, 1946. He is at present with the Office of the Veterans Administration in Manila. With him came two other officials of the same office. They conferred with agricultural education personnel concerning the possibility of sending some veterans to the Rural High School for agricultural training.

# THE EXPERIMENT STATION

LIST OF AVAILABLE CIRCULARS AS OF MARCH, 1948

No. 2.—Bud Rot of Coconut..... *By G. O. Ocfemia*

No. 8.—Horse Breeding in the Philippines..... *By V. Villegas*

No. 10.—Practical Directions for Coffee Planting..... *By Pedro A. David* (Revised by Charles Fuller Baker, Dean, College of Agriculture, 1917–1927.)

No. 11.—The New College Copra Drier—Prepared in the Department of Agricultural Chemistry with the Cooperation of the Department of Agronomy and Extension. (Revised)..... *By Moises M. Kalaw*

No. 16.—A Simple Farm Record for the Farmer ..... *By F. M. Sacay*

No. 17.—College Trapnest..... *By F. M. Fronda and P. S. Paje*

No. 18.—Surveying for Area with a Surveyor's Staff.. *By Alexander Gordon*

No. 20.—Amount of Nutrients in Philippine Food Materials..... *By F. O. Santos and S. J. Ascalon*

No. 23.—Curing Pork and Making Sausage for Home Use..... *By Mariano Mondoñedo*

No. 24.—Construction and Operation of Silos in the College of Agriculture ..... *By J. P. Esguerra*

No. 27.—Bunchy-top of Abacá ..... *By G. O. Ocfemia*

No. 28.—Cotton Culture..... *By Eulalio P. Baltazar*

No. 29.—Collegiate Education in Agriculture..... *By Leopoldo B. Uichanco*

No. 30.—What Should Filipino Ornamental Gardens and Ornamental Plants Be? ..... *By N. B. Mendiola*

No. 31.—How to Slaughter and Dress Farm Animals —*By Valente Villegas and M. Mondoñedo*

The price of the circulars listed above is thirty centavos (₱0.30) each.

---

A HANDBOOK OF PHILIPPINE AGRICULTURE..... ₱5.00

---

ALL ORDERS WITH PAYMENT SHOULD BE ADDRESSED TO THE BUSINESS MANAGER, THE PHILIPPINE AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES.

# The Philippine Agriculturist

(Formerly The Philippine Agriculturist and Forester)

*Published by the* COLLEGE OF AGRICULTURE
UNIVERSITY OF THE PHILIPPINES

Vol. I—2
Vol. III—9-10
Vol. IV—3, 5-6, 7
Vol. V—2, 3, 5, 6, 7, 8, 9, 10
Vol. VI—complete
Vol. VII—complete
Vol. VIII—3, 4, 5, 6, 7, 8-9, 10
Vol. IX—3, 4-5, 8-9
Vol. XI—3, 4, 5, 6, 7, 8
Vol. XIII—1, 3, 4, 5, 6, 8, 10
Vol. XIV—complete
Vol. XV—complete
Vol. XVI—3, 7, 8, 9, 10
Vol. XVII—6, 7, 8, 9, 10
Vol. XVIII—complete
Vol. XIX—complete
Vol. XX—complete
Vol. XXI—complete
Vol. XXII—complete
Vol. XXIII —complete
Vol. XXIV—complete
Vol. XXV—complete
Vol. XXVI—complete
Vol. XXVII—complete
Vols. XXVIII, XXIX and XXX burned.
Separate indices to Vol. I to XXVI
Consolidated index to Vol. I to XX

**Back copies sell at 50 centavos.**

**Consolidated index 50 centavos excluding postage**

Send your order to the BUSINESS MANAGER, THE PHILIPPINE AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES.

# A Handbook of Philippine Agriculture

A book on practical agriculture issued in commemoration of the Thirtieth Anniversary of the College of Agriculture. Contains useful information on different branches of agriculture. Of great practical value to farmers, farm managers, agricultural teachers, students, extension workers, and researchers.

*Cloth, 803 pages, 4½" × 6¾"*

Price postpaid:

Philippines ..... ₱5.00
Foreign countries..... $2.50 (U.S. currency)

Send your order to THE PHILIPPINE AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES